MODELING, SIMULATION, AND ANALYSIS FOR STATE AND LOCAL EMERGENCY PLANNING AND RESPONSE

OPERATIONAL REQUIREMENTS DOCUMENT

REPORT DHS82T2

Denise R. Duncan
Joana R. Gribko
Roja Kolachina
Myra T. Lee

LMI
GOVERNMENT CONSULTING

JANUARY 2009

NOTICE:

THE VIEWS, OPINIONS, AND FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF LMI AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL AGENCY POSITION, POLICY, OR DECISION, UNLESS SO DESIGNATED BY OTHER OFFICIAL DOCUMENTATION.

Executive Summary

Responding to catastrophic events, man-made or natural, places tremendous demands on governmental organizations at all levels. To respond as efficiently and effectively as possible, these organizations must determine the events, or threats, that are most likely to occur in their area of responsibility, prioritize the threats based on their predicted impact, and determine how to best apply their resources to mitigate, and prepare for, the threats. Because each threat's impact can vary depending on any number of conditions, multiple scenarios must be considered for each threat.

The Department of Homeland Security (DHS) has defined 15 National Planning Scenarios, along with a Target Capabilities List, which describes needed capabilities related to the four homeland security mission areas: prevent, protect, respond, and recover. In addition, state and local emergency personnel must have plans in place for managing emergencies in their areas of responsibility.

To support the preparation and response phases at the state and local levels, DHS's Directorate for Science and Technology (DHS/S&T) wants to provide an integrated suite of modeling tools to state and local emergency planners and responders. The challenge is to provide tools that can be used by both well-funded jurisdictions and those with little funding and little or no information technology support. In support of that goal, LMI conducted a gap analysis to identify the models and other tools needed by a broad spectrum of emergency services (ES) stakeholders for preparation and response, and considering the results of the gap analysis, we identified both functional requirements for software and the operational capabilities needed to implement and support that software.

The functional requirements we identified are high-level, core areas of functionality that the ES community considers necessary in any model or tool they might use to prepare for, respond to, and recover from an emergency. The following functional requirements are key:

- Models and tools to support modeling for the 15 National Planning Scenarios should be provided to all jurisdictions by DHS.

- Models and supporting tools should accept inputs from, and outputs to, commonly available software such as the Microsoft Office suite of products.
- Jurisdictions need a process to integrate model and tool use into everyday operations.
- To maintain continuity of operations, software must look and operate the same, regardless of mode: networked, local area network only, or standalone laptop.
- Software must integrate with other applications easily, scale up, and use familiar terminology, for support by nontechnical emergency personnel.
- Adoption and implementation of software must be possible for both well-funded jurisdictions and jurisdictions with no overhead funds.
- Maintenance of software must be very low cost and require minimal technical skills from using jurisdictions.
- Asset management tools must exchange data using some common, easy-to-use, and low-cost or no-cost standard or format.
- Software must include more than the technical information needed to implement it. Jurisdictions need information on different implementation paths and tools (such as checklists) to help them plan for, deploy, and support software.
- Jurisdictions need models to support three types of risk analyses: overall risk assessments, in-depth analyses of high-risk hazards and threats, and analyses of low-probability/high-impact threats.

The operational requirements we identified represent barriers that hamper the ability of almost all jurisdictions to adopt new models and tools, although the impact varies depending on factors such as location, population, executive support, and structure and size of the ES organization. The following are key operational requirements:

- Approaches and methods to easily and effectively engage all planning and general information sharing across all disciplines
- Guidance at the federal, Federal Emergency Management Agency region, state, and local levels on data and information sharing
- An integrated process to define the roles of the disciplines, the key responsibilities, and both the shared and the role-specific privileges of operations management software

- Decision support information from a trusted source in the ES community
- An authoritative source for guidance and standards in effect and a regular review process to ensure that they remain viable and up to date
- At the federal level, clear differentiation between what should be regarded as "guidance" and what constitutes "standards"
- Flexible, adaptable, and changeable processes for use by jurisdictions during both preparation for and response to an event
- Policies that support collaborative planning, risk-based funding, and processes or methods to resolve inter-jurisdictional differences of opinion and to address political issues.

DHS/S&T needs to define the functional requirements in more detail and then identify the specific technical requirements for modeling, simulation, and analysis. DHS/S&T also needs to address the operational requirements within its purview. However, some of these requirements can be addressed only by other organizations within DHS. S&T should partner with those organizations to ensure that the operational requirements are fully addressed. These partnerships are critical, because some operational requirements must be met if DHS is to overcome the barriers to the adoption of modeling, simulation, and analysis tools by the entire ES community.

Contents

Figures

Tables

Chapter 1
Introduction

Responding to catastrophic events, man-made or natural, places tremendous demands on governmental organizations at all levels. To respond as efficiently and effectively as possible, these organizations must determine the events, or threats, that are most likely to occur in their area of responsibility, prioritize the threats based on their predicted impact, and determine how to best apply their resources to mitigate, and prepare for, the threats. Because each threat's impact can vary depending on any number of conditions, multiple scenarios must be considered for each threat.

At-a-Glance

DHS/S&T is working to provide an integrated suite of modeling tools to state and local emergency planners and responders. The ability to use such tools varies greatly among the various local jurisdictions and tribal governments. The challenge is to produce tools that can be utilized by both well-funded jurisdictions and those with less funding and little or no IT support.

The Department of Homeland Security (DHS) has defined 15 National Planning Scenarios (NPSs), along with a Target Capabilities List, which describes needed capabilities related to the four homeland security mission areas: prevent, protect, respond, and recover. In addition, state and local emergency personnel must have plans in place for managing emergencies in their areas of responsibility.

In this operational requirements document, as well as in two companion documents (a mission needs statement and a concept of operations), we use the terms *emergency management* (EM) and *emergency services* (ES). We define those terms as follows:

- Emergency management—organizations charged with the managerial function of creating the framework within which communities reduce vulnerability to hazards and cope with disasters.[1] The emergency management community includes local, regional, tribal, and national agencies charged with maintaining the programmatic framework, managing program requirements, and administering local and federal funding.

- Emergency services—organizations that provide for public safety by the delivery of services such as law enforcement, firefighting, emergency medical, search and rescue, and the like. The emergency services community includes all the emergency services providers/responders, including EM agencies.

Emergency management is often described as having a life cycle with specific phases. The three most commonly recognized phases are preparation, response,

[1] FEMA's independent study course IS230, Principles of Emergency Management.

and recovery. Other categorizations exist; for example, the Federal Emergency Management Agency (FEMA) website mentions prevention, mitigation, and risk reduction, but these activities can take place as part of preparation and are not phases, per se.

To support the preparation and response phases at the state, local, and tribal levels, DHS's Directorate for Science and Technology (DHS/S&T) would like to develop a suite of models and other tools that state, local, and tribal planners can use for modeling, simulation, and analysis of likely threat scenarios. DHS/S&T's focus is on enabling its customers, the DHS components, and the components' customers—including federal, state, and local emergency responders—to achieve their vital mission of securing the nation. DHS/S&T also emphasizes that the implementation of such technology must focus on its use as a support "tool" that can augment, but does not in any way replace, essential human decision making.

DHS/S&T tasked LMI with conducting a gap analysis to identify the models and other tools needed by a broad spectrum of ES stakeholders for preparation and response and, considering the results of the gap analysis, with developing a mission needs statement, an operational requirements document, and a concept of operations. This report is the operational requirements document. It describes both the functional requirements for software and the operational capabilities needed to implement and support that software.

BACKGROUND

According to good software development practices, before software—whether a model or another type of tool—is built or bought, requirements for the software must be developed. Requirements for what the software must do and how it must behave are called functional requirements. Other requirements, called operational requirements, describe operational and support concepts in sufficient detail for program and support planning. Both functional and operational requirements must be satisfied to develop models and other tools that will

- fulfill the users' needs to perform certain functions,
- behave the way users need it to behave, and
- be adopted and sustained by the user community.

The functional requirements are general statements of software needed, and the operational requirements are more detailed statements about the support infrastructure and what is needed to enable stakeholders to obtain and use software models and tools. The functional requirements are general statements because it is difficult for stakeholders to articulate the specifics of what some needed software would do, without having seen examples of different types of software. In contrast, stakeholders can be quite specific about their operational requirements because they are all too familiar with the barriers to software use.

STUDY APPROACH

This task called for interviewing stakeholders to gather information about the types of software they need to prepare for and respond to a threat. Our first steps were to draft interview guides (one for state-level emergency management agencies, or EMAs, and one for local jurisdictions) and construct a sample of stakeholders who adequately represent the ES community. We strove to include as many types of local jurisdictions as possible, to correct a perceived bias in prior studies toward larger jurisdictions. A team was assembled that included experts in emergency management, information technology (IT), and project and program management, as well as individuals who are experts in eliciting and analyzing software requirements.

The team interviewed state emergency managers individually and conducted group interviews with local jurisdictions to include as many disciplines (emergency management, fire, law enforcement, public works, medical, transportation, etc.) as possible. In addition, the team interviewed non-governmental organizations (NGOs) to understand their needs and their relationships with and dependencies on their government counterparts. We wanted to consider the role of NGOs because they are an integral and important part of many communities across the nation. In other words, we wanted to understand how local jurisdictions can work with their community counterparts and how shared models and tools might be utilized in the field. A total of 90 individuals participated in the interviews. Table 1-1 summarizes the demographics of the interview participants.

The team completed a total of 48 individual and group interviews between March and August 2008; 14 of these were with state-level employees, and 32 were with local jurisdictions (two jurisdictions required a second interview). These jurisdictions were of various sizes and types (rural, city, county, tribal, and large urban areas) and in a variety of geographic locales (island, mountainous, coastal, and plains areas). All interview participants contributed voluntarily, and all information was obtained based on the understanding that it was not for attribution.

The team used a consistent process for all interviews. First, letters were sent to those in our sample to let them know of the study. Then, we discussed the interview concepts and process with four individuals at the state level, refined the interview guides, and began scheduling interviews. In advance of each interview (whether state or local), the team sent participants the interview guide and a description of the purpose of the study and areas of interest. At the local level, the interview included questions on local hazards; planning, training, and exercising; response operations; recovery; daily use of computer tools; funding; and any topic the interviewees wanted to discuss. Interviews were conducted by teleconference; interviewees were offered a copy of the notes taken, if they so wished. In addition, we collected information from the interviewees about the software and other tools that they use. Appendix A lists them.

Table 1-1. Demographics of the Interview Participants

Population	Jurisdictions	EMA	Fire	Police	Public works	Medical	Elected	Other	Total
1–14,999	1 county, 1 city, 1 tribe	3				2			5
15,000–49,999	2 counties	2	1	1		1			5
50,000–99,999	2 counties	3	1						4
100,000–249,999	7 cities, 2 counties, 1 tribal consortium	9	10	2	2	3	1		27
250,000–499,999	3 cities, 4 counties	7	1	1		2			11
500,000–999,999	4 cities	4	2	2	1	3		1	13
1,000,000–4,999,999	1 county, 1 NGO	1				1		1	3
Over 5,000,000	1 city, 1 NGO	1				1		1	3
States	10 states	14					1		15
Pretest	State	4							
Total		44	15	6	3	13	2	3	90

The team analyzed the interview notes and the information on software and other tools used by the interview participants to develop this operational requirements document.

ORGANIZATION OF THIS REPORT

The remainder of this report is organized as follows:

- Chapter 2 describes the functional requirements that the software must perform to support the preparation for and response to an emergency.
- Chapter 3 describes the operational conditions and support that must be in place to ensure the successful adoption and operation of the models and other tools needed by the ES community.
- Chapter 4 presents conclusions.

The appendixes contain supporting detail.

Chapter 2
Functional Requirements

Functional requirements describe what the software (modeling, simulation, and other analysis tools) must do for the users of the systems—in other words, what functions the software must perform to support the preparation for, response to, and recovery from an emergency. They also describe how that software must behave. Some general software requirements apply to any software developed for the ES community. However, this chapter focuses on more specific functional requirements:

- Continuity of operations
- Models
- Other tools
- Integration
- Usability.

The following sections provide an overview of these requirements, synthesized from the information obtained during interviews. Appendix B contains the complete list of functional requirements identified by our interviewees.

Requirements Applicable to All Software
Software must look and operate the same, regardless of mode: networked, LAN only, or standalone laptop.
Software must integrate with other applications easily, scale up, and use familiar terminology, for support by nontechnical emergency personnel.
Adoption and implementation of software must be possible for both well-funded jurisdictions and jurisdictions with no overhead funds.
Maintenance of software must be very low cost and require minimal technical skills from using jurisdictions.
Asset management tools must exchange data using some common, easy-to-use, low-cost or no-cost standard or format.
Software must include more than the technical information needed to implement it. Jurisdictions need information on different implementation paths and tools (such as checklists) to help them plan for, deploy, and support software.

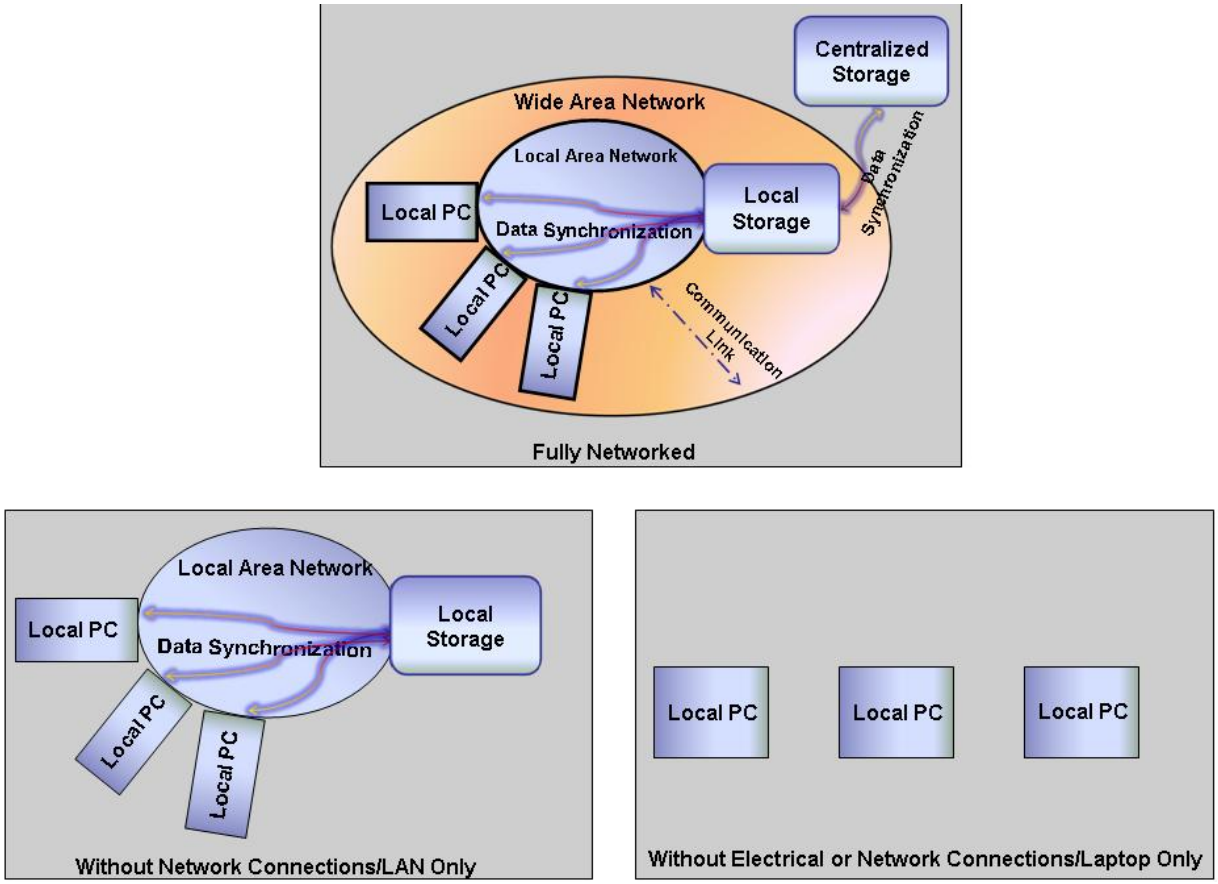
CONTINUITY OF OPERATIONS

Because of the conditions under which the ES community must work—conditions in which telephone, power, and other infrastructure may be compromised—software must work in several modes:

- Networked
- Without network connections—standalone computers or local area network (LAN) only
- Without electrical power—laptop or hard-copy only.

Figure 2-1 depicts the modes of operation.

Figure 2-1. Modes of Operation



To the extent feasible, the software should look and operate the same, regardless of the mode of operation. The ability to operate seamlessly during normal operations or during an event implies the following:

- Data stored in a central repository must be redundantly stored locally, which makes the data available to applications, regardless of location.
- Single data entry must serve both storage locations.
- Synchronization of data once network connectivity is restored must take place without much effort on the part of the local users.
- Input and output formats must transfer to paper easily, so that loss of laptop capability does not impede data capture and use.
- Process flow for all modes of operation must be as similar as possible.

Local jurisdictions can provide little support for overhead functions, such as training on the use of software. Often, local users are acting in multiple roles. It is rare

that they have any support for IT, whether selecting it, installing and maintaining it, or operating it. Thus, for these users to adopt and use models and other tools, the software must do the following:

- Integrate with software used to support daily operations, so that users are familiar with the software and can readily use it in emergencies. For example, event management models and other tools can be used during normal operations and during emergencies.
- Scale up or down to accommodate any size event.
- Use terminology and process flows that are familiar to the users. For example, to be as intuitive as possible, input screens should mimic the forms used for manual data capture.
- Be available at little or incremental cost.

Continuity of Operations

The ES community needs a supporting infrastructure 24/7, 365 days a year that provides peak performance when conditions are at their worst.

Models and tools developed for these users must accommodate both well-funded jurisdictions that have IT support and jurisdictions with little or no support. This may require designing models and tools around mandatory core functions, with optional advanced features. Jurisdictions with sufficient funding to provide more training, technical support, and equipment (such as mobile data terminals in all vehicles) could implement both the core functionality and the advanced features. Core functionality should be designed to allow for infrequent updates, while modules with advanced features could be updated as frequently as desired.

A key factor in a jurisdiction's ability to adopt a model or tool is maintenance. Often, maintenance for both the software and the supporting information technology precludes the use of freely available models and tools. Although maintenance is clearly an operational requirement, it is so limiting that it generates some functional requirements for the software:

- Models must be simple to download and install. Models must be designed to neither require changes to, nor have any impact on, software already in use by jurisdictions.
- Documentation is a key part of model delivery and must be written for a nontechnical audience.
- The release strategy for models must take into account very limited technical support. For example, core functionality should be released as a simple download and installation; patches or incremental upgrades could be used for add-ons.

- Each model should have a support mechanism. Support could be provided by e-mail or telephone help desk, a users forum for peers to help one another, and other mechanisms.

Knowing what resources are available is key to effective response, so tracking of assets and resources is a very common requirement. However, to be effective, asset tracking tools must provide the capability to exchange asset availability information with other jurisdictions (for mutual aid, for example). To do that, the assets must be categorized and described in a consistent, standard way. This calls for asset management tools that do the following:

- Use a common standard to describe assets. Interviewees mentioned the National Incident Management System's Resource Management Resource Typing definitions, but said they did not want to adopt them if they are not final.

- Provide asset management capability and support or integrate with logistics functions.

- Provide asset visibility and tracking for human assets (including volunteers), equipment (with electronic tracking mechanisms), and other resources.

- Provide asset accountability functions.

Tools and Data Exchange

Models and tools must be easy to use and maintain, have good documentation, and support asset management needs.

Tools developed for state and local use should provide road maps for state-wide implementation. Currently, when a state or county implements an EM system—for example, a web-based emergency operations center (EOC) or WebEOC—there is little coordination with other county or local emergency management agencies (EMAs). Planning for deployment state- or county-wide must consider, and clearly communicate, the following:

- Identification of individuals who will have access to specific parts of the system, under both normal and emergency conditions (generally based on the role an individual plays)

- Timing and type of training that will be offered to different users

- Use of multiple modes of delivery

- Negotiation of favorable licensing structures across state lines based on bringing multiple jurisdictions to the table at one time

- Compatibility of the new installation with previously installed versions

- Integration of the new installation across existing platforms and applications.

MODELS

A model is an approximation, representation, or idealization of selected aspects of the structure, behavior, operation, or other characteristics of a real-world process, concept, or system. A simulation is a model that behaves or operates like a given system when provided a set of controlled inputs.[1]

In the ES community, users need models to assist with preparing for, responding to, and recovering from events and disasters. They need information so they can make decisions on how they will respond to various emergency scenarios. One may think of these models as decision support tools.

Modeling needs vary from jurisdiction to jurisdiction due to such differences as size, makeup, hazards or threats, and government structure. Planning at a regional level can occur for hazards common across that area, and local planning would address threats unique to that locality. Therefore, any model created for the ES community must be flexible enough to accommodate the differences. Below are some examples of differences that models must accommodate:

At-a-Glance

In simple terms, a model is a computer-based representation of a real-world system; a simulation is a representation of the operation of a system over time.

- Population density
- Hazards and threats (general, regional, seasonal, and industry specific)
- Government hierarchy (towns vs. townships, for example)
- Placement within the government hierarchy (town, city, county, state, tribal nation, territory)
- Geography (for example, percentage of land in agriculture or island vs. continental)
- Resources
  - Equipment (locally controlled and otherwise available in an event)
  - Human resources, including types of volunteers and NGOs
  - Funding sources

[1] Dr. Charles Hutchings, "Modeling and Simulation for Homeland Security" (presentation, National Defense Industrial Association Modeling and Simulation Committee, June 2008). Dr. Hutchings, the director of the recently established office for modeling and simulation within DHS/S&T's Test and Standards Division, is developing the modeling and simulation vision and strategic plan. To ensure that our efforts coordinate with Dr. Hutchings's emerging strategy, we used his definitions for modeling and simulation, and we will comply with any standards from that office as they evolve.

- Levels of authority/degree of autonomy
- Types of public services provided.

As one can imagine, the current modeling capabilities of the ES community cover a wide range—from nonexistent to quite sophisticated. Available resources, both human and financial, are the drivers of the ability of a given jurisdiction to model events and their plans. In other cases, threats encountered by a jurisdiction affect the ability to accurately model what they are most likely to face. In addition, access to appropriate and current data plays a large role in the ability of a jurisdiction to produce usable model results.

Factors Affecting the Use of Models by a Jurisdiction

Threats for which the jurisdiction must plan:

- Level of funding/tax base
- Sources of revenue within the jurisdiction
- Form of government
- Degree of autonomy/level of authority
- Organizational position and support of response agencies within government
- Size of the jurisdiction
- Terrain
- Location and type of critical infrastructure
- Population density
- Special and seasonal events
- Access to and distance from external resources
- Availability of data to input to models.

Overall, our interviewees described more specific requirements for software, and for integration of software, than they did for specific models. They do not perceive that lack of modeling tools is an urgent need, perhaps because they are very comfortable working without the various software tools (such as asset management software) and operate day-to-day using more basic tools, such as word processing and spreadsheets. In addition, they have a limited understanding of how models could work for them and what impact models could have.

When interviewees identified a modeling need, it was in the context of the preparation phase. However, they also stated that they needed to use the same tools when responding to an event. In other words, models used for planning must also be usable to support response, including input of new data as an event unfolds. Using the same models and data in both the preparation and response phases enables the smooth transition to a constantly changing response mode. They were not generally aware of the benefits of using modeling tools for developing exercises.

In interviews, the ES community requested several specific types of models and other tools to support the decisions they need to make during an emergency:

- Risk analysis
- Mass casualty estimation
- Evacuation planning

- Scenario-based planning
- Earthquake modeling
- Situational awareness
- Resource tracking
- Weather estimation
- Simulations for training and exercising.

The following subsections address each of these types of models.

Risk Analysis

A common requirement raised in interviews with jurisdictions of all types is modeling to support risk analysis. Although some jurisdictions use tools for specific threats—for instance, HAZUS for flooding, hurricane winds, and earthquakes and CAMEO, ALOHA, and MARPLOT for hazardous material risk—overall, risk modeling is done inconsistently across the ES community. Many jurisdictions do not even use freely available tools. This may be due to their limited understanding of how models could work for them and what effect the models could have. It may also be due to a lack of human and computer resources to support training and use of such tools.

Risk Models

Many jurisdictions are not using existing risk modeling tools, either because they are unaware that they exist or they have limited knowledge of the tools and their capabilities.

Jurisdictions need models to support three types of risk analyses:

- *Overall risk assessments.* Risk assessment provides a general overview of the most probable threats that could occur in a jurisdiction. Risk analysis helps jurisdictions to more fully analyze all threats and hazards and to prioritize efforts for the variety of threats they may face. Jurisdictions can then allocate appropriate effort, time, and resources to preparing for threats posing the most risk to their community. A jurisdiction can develop a quick and simple overview of potential threats by using FEMA's Vulnerability Analysis Chart, a basic matrix into which the jurisdiction adds its empirical knowledge of the area, along with information about available resources and capabilities.[2] (Appendix C contains an example of how the chart is used.)

- *In-depth analyses of high-risk hazards and threats.* Specific threat analysis enables jurisdictions to further refine their plans and allocate preparedness resources appropriately. Resulting output from a specific threat analysis becomes the input to a response model, as well as inputs to training and

[2] The chart is available at http://www.fema.gov/business/guide/section1b.shtm.

exercise scenarios. Freely available analysis tools exist for specific hazards such as floods, hazardous materials, earthquakes, and hurricanes.

- *Analyses of low-probability/high-impact threats.* Typically, these types of threats (for example, an earthquake or a terrorist attack) get little attention beyond the overall risk analysis because the probability of occurrence is so low, and the more likely hazards and threats use all the available planning resources. As a result, jurisdictions focus their planning resources on the more likely threats. Another difficulty is that estimates of the probability of an event often are based on history; thus unprecedented events (for example, the scale of Hurricane Katrina) may get little attention in specific hazard/threat analysis. Nevertheless, these threats must be assessed and planned for appropriately. For example, the majority of the threats represented in the NPSs were regarded by our interviewees as low-probability threats, yet they have a potential impact at the level of the 9/11 attacks. Without planning at the local level for these threats and incorporating the changes into existing plans, our response to these disasters will be little improved from our response in 2001.

Risk Analysis

Risk analysis is the first step in threat analysis and planning. If the investment in tools is not made to support this, then jurisdictions will not be sufficiently prepared to handle threats and disasters. Jurisdictions need to perform overall risk assessments, in-depth analyses of high-risk hazards and threats, and analyses of low-probability/high-impact threats.

Risk models may require some additional tools to be fully effective. For example, once the specific threat analysis is complete, its output is used to develop the response plan. Methods for developing response plans vary widely, depending typically on whatever tools the planner has available. One interviewee requested a standard tool to do SWOT analysis (analysis of strengths, weaknesses, opportunities, and threats). SWOT analysis is used frequently in other settings, but no standard method has been developed for use in the ES community. SWOT analysis would allow planners to directly map specific threats to various factors, such as planned mitigation efforts or memorandums of understanding (MOUs), based on their expected positive impact.

With the variety of threats for which the ES community must plan, professionals need accurate supporting data to analyze the various threats at the level of detail necessary. Jurisdictions also require the ability to model capabilities needed to respond to an event.

The reality of obtaining executive and budgetary support to prepare for any specific threat is most often dependent on a community's resources and the relative level of risk. Funding may be declined for a low-level threat when weighed against other critical impending priorities, even if the potential consequences could be exceedingly high. The potential low level of risk is often felt to be acceptable because officials consider it unlikely to occur in the foreseeable future, meaning their term in office.

Mass Casualty Estimation

A primary responsibility during the response phase is to manage the care and movement of those casualties needing assistance. To do so expediently, interviewees at every level of emergency management noted the need for a model to estimate how many people will require which types of services and what resources will be needed to transport them to the health care facility that can best manage their care. The model will enable the ES community to envision the number and types of casualties that may result from a given incident. Even if the output of the model shows that casualties would overwhelm capabilities and resources, it would provide reliable, defensible estimates for making the case for budgetary support, for mutual aid, for requesting Federal Metropolitan Medical Response System assistance, etc. The model's output must then become the input to plans, to provide the capability for managing such an event in a given jurisdiction. Such models must be user friendly, easy to update frequently, and able to process inputs quickly during an event, under adverse operating conditions, with complicating factors such as fatigue and stress.

Evacuation Planning

Interviewees requested models to assist them with planning evacuations under a number of scenarios, including a variety of complicating factors. Some interviewees can use a geographic information system (GIS) to overlay flood maps to identify areas that may need to be evacuated, and some can even integrate that with reverse-911 systems. But none of those interviewed can model, for example, the use of a variety of vehicle types and capacities, such as buses, to evacuate urban sectors, or the numbers of vehicles coming from different areas overlaid on the real-time capacity of the roads in the area.

Evacuation modeling is particularly important because exercises to simulate evacuation are infeasible; they require too many participants, and they can tie up traffic, negatively affecting business and transportation. However, evacuation modeling is immature; the need for such modeling provides a potential opportunity for a variety of groundbreaking research and development efforts.

Scenario-Based Planning

National Planning Scenarios
Improvised nuclear device
Aerosol anthrax
Pandemic influenza
Plague
Blister agent
Toxic industrial chemicals
Nerve agent
Chlorine tank explosion
Major earthquake
Major hurricane
Radiological dispersal device
Improvised explosive device
Food contamination
Foreign animal disease
Cyber attack

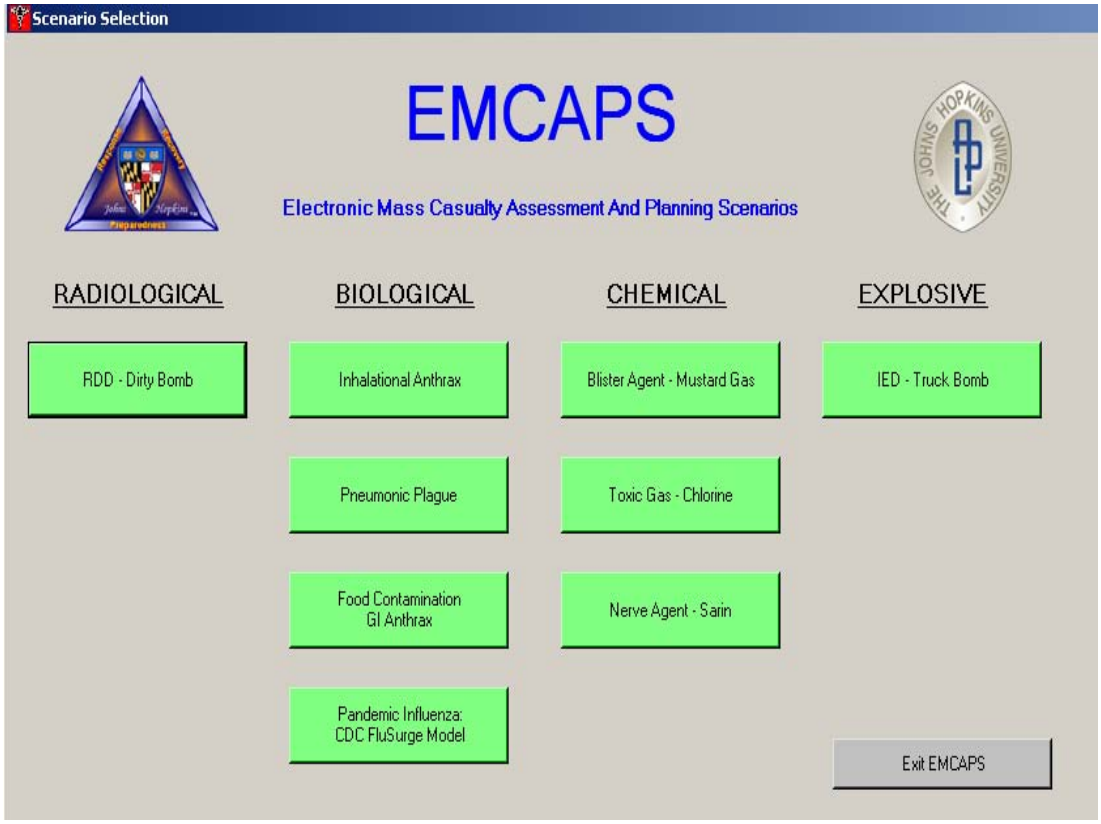
From a federal perspective, the NPSs are a key planning requirement for all jurisdictions, regardless of location, size, etc., throughout the United States. Almost all interviewees acknowledged the importance of the NPSs, but noted that the specific threats in the NPSs do not align well with the highest-probability threats in their jurisdiction. In addition, they believe that addressing the NPSs in their plans places an undue, and inadequately funded, burden on communities, especially where resources are extremely limited. Because local jurisdictions are minimally funded to respond to the most likely threats and hazards, with no surplus of funding for low-probability/high-risk threats, they generally do not plan for any of the NPSs, with the exception of pandemic influenza, for which some larger jurisdictions have received grant funds to develop plans. This need to plan for the NPSs is linked to the need to estimate mass casualties and to the requirement to support modeling and planning for low-probability/high-impact risks.

Jurisdictions would be able to plan for the 15 NPSs if they had a model that supported estimating casualties and that automatically computed required resources (using the guidelines in the Target Capabilities List). The following are key NPS modeling requirements:

- Users must be able to enter certain parameters describing the demographics and conditions in their jurisdiction.
- Models must provide estimates of needed resources and capabilities.
- Model outputs must be exportable in common formats for local detailed planning efforts.
- A repository must be provided for centrally maintained standard models.

One tool—Electronic Mass Casualty Assessment and Planning Scenarios (EMCAPS)—has already been designed to model most of the NPSs. Figure 2-2 shows the user entry screen for EMCAPS.

Figure 2-2. EMCAPS User Entry Screen



Most interviewees were unaware of its existence. EMCAPS could help state and local jurisdictions articulate specific requirements for the needed modeling tools for the NPS and mass casualty scenarios. EMCAPS could be used in a joint application development environment as a prototype to, for example, show users what is feasible and help them understand how much explanation is needed.

Earthquake Modeling

Jurisdictions plan for many different types of events. However, one natural disaster event—an earthquake—stood out as a specific modeling need. Although HAZUS (http://www.fema.gov/plan/prevent/hazus/index.shtm) is available for earthquake modeling, as well as for wind and flood modeling, most interviewees seemed to be unaware of the tool. Those who know about HAZUS believe that it does not provide sufficient analysis. The ability to integrate earthquake modeling with other types of models (such as evacuation models) and related planning tools is key in order to create a comprehensive view of the disaster landscape.

Situational Awareness

One of the main issues for responders, with respect to modeling scenarios across the preparedness and response phases, is the ability to keep up with changing conditions, as well as information such as response resources, as an event or

incident unfolds. Interviewees were able to state the general need for some tools, but contributed little information on specific requirements.

During response, responders work from the plan or, in some cases, purely from experience, adapting on-the-fly to suit the actual event conditions. If the model that was used to develop the response plan is updated to reflect the change in conditions, the model itself may be used to provide accurate, sharable information for situational awareness.

Resource Tracking

Once the situation changes, the resources being applied to an incident will need to change. Therefore, responders need to know the availability of their own resources and of those available from other jurisdictions. To meet that need, jurisdictions need a way to track their resources and to share that information with other jurisdictions. Interviewees were aware of the needed restrictions on viewing of others' resources, but discussed the possibility of using a shared application for resource inventories for all jurisdictions that operate from a shared EOC. The EOC would be able to see all the resource data, but access by others must be controlled on a need-to-know basis. For example, each jurisdiction could see data on its own resources (equipment, skilled personnel, etc.) and, under certain conditions (need to know), data on the resources available to them from other jurisdictions.

A clear picture of how an event is unfolding is crucial to the success of the efforts of responders and other emergency personnel. If resource deployment information can be integrated with GIS-based event models, an even clearer operating picture can be provided. The timeliness and ease of integration of the data to create that picture is key; the ES community requires real-time capability with respect to event conditions as well as resource availability.

Weather Estimation

Interviewees asked for a model to address weather-related data. Specifically, they want a model that includes details such as inches of rain per hour for flooding, snow pack in the mountains that could result in spring flooding, and other weather events/statistics.

Potential flooding should be modeled using GIS and overlaid on the current flood plain maps and should take into account the potential for damage caused by debris loading of the floodwaters. For example, the amount of debris picked up by floodwater in a mountainous region heavily laden with timber fall and underbrush may destroy a bridge on the way to lower elevations, while the same amount of floodwater on an open plain with little vegetation and little infrastructure would have a totally different effect.

Simulations for Training and Exercising

Preparing for an event requires that people, plans, and systems be trained and exercised.[3] Training personnel—whether with distance-learning tools, models, or technology or with respect to standards and plans—is difficult due to the lack of funding and time and to the high staff turnover in the ES community. Often, personnel cannot give up hours spent taking care of day-to-day requirements of their job in order to train; they have too much on their plate already and may have multiple roles as well.

To address these problems, jurisdictions require models that enable them to create simulated exercises that closely represent reality. In general, computer-based models can offer a virtual-reality view into events, be scenario based, cover the many roles that one person may have during a given event, and represent much of what an actual response might look like to a responder. Moreover, such training is effective and efficient.

OTHER TOOLS

A tool, by definition, is an item that typically provides an advantage in accomplishing a task or enables the accomplishment of a task that cannot be performed without the tool. The general requirements for ease of use, survivability, maintenance, and cost apply to any tools that the ES community will use to support event management. Some tools are needed to assist jurisdictions with complying with laws, statutes, and regulations and with communicating and disseminating event information to their local communities. All tools must work seamlessly in day-to-day operations and during an event.

The tools that interviewees need are of three types:

- Central repositories
- Tracking
- Information dissemination.

The following subsections address these requirements.

[3] The DHS office for modeling and simulation references a National Institute for Standards and Technology report on the use of modeling and simulation for training. The report is available at http://www.mel.nist.gov/msidlibrary/doc/NISTIR_7295.pdf.

Central Repositories

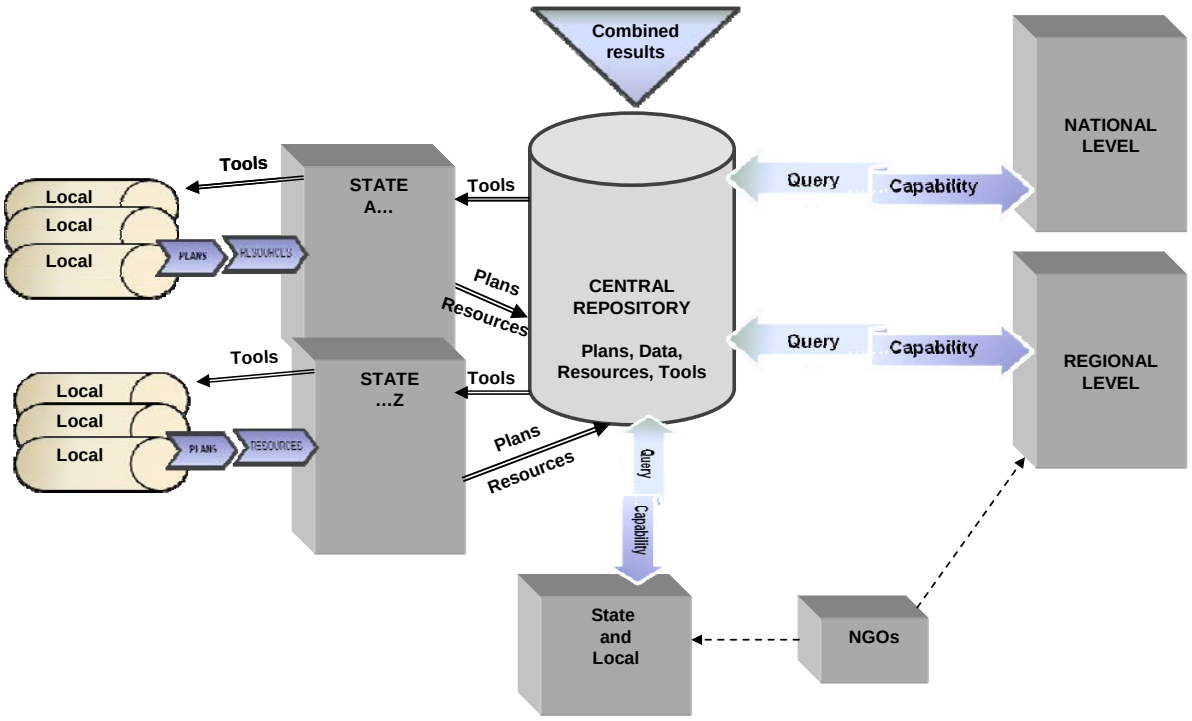
Many interviewees articulated the requirement for shared repositories. Specifically, they noted the need for

- centralized storage of information on assessments, plans, resources, and other critical data and
- a central location for all available tools that support preparation and response efforts, including descriptions, terms of use, installation guides, and so on.

Many jurisdictions mentioned that offices often had their own systems and software that housed information, but that sharing the information—both within jurisdictions across disciplines and between jurisdictions—was difficult or impossible. The sharing of tools seems to be equally difficult, due to such things as differences in infrastructure, lack of information on availability of tools, lack of technical understanding of the tools, and lack of peer-to-peer sharing of information on tools in use.

Satisfying the need for sharing information on tools, or the tools themselves, requires an inventory of tools in use, the conditions of their use, their costs, and the infrastructure needed to support them. Figure 2-3 depicts the concept of how this information could be shared via a central repository.

Figure 2-3. Conceptual Central Repository for EM Models and Other Tools



The following requirements pertain to central repositories:

- Document exercises and simulations based on information from other systems, such as WebEOC, to capture and retrieve after-action reports and lessons learned documentation
- Capture specific information about events, which can then be shared among response agencies
- Provide data and tools for risk analysis, deployment and tracking of available resources, situational awareness, and preparation of reports and briefings
- Enable users to discover what tools others are using and what type of access exists for these tools
- Ensure protection of sensitive data in accordance with laws, regulations, and policies that provide for access to public information
- Provide locations for points of distribution (for resources, supplies)
- Support management of regional response assets
- Provide state-wide GIS capabilities along with information on who owns the land and populated areas and where property lines are
- Be usable in the field to document damages and losses
- Provide real-time internal and external resource inventories
- Provide short- and long-term shelter information
- Provide access to plans and planning information.

Sharing Data

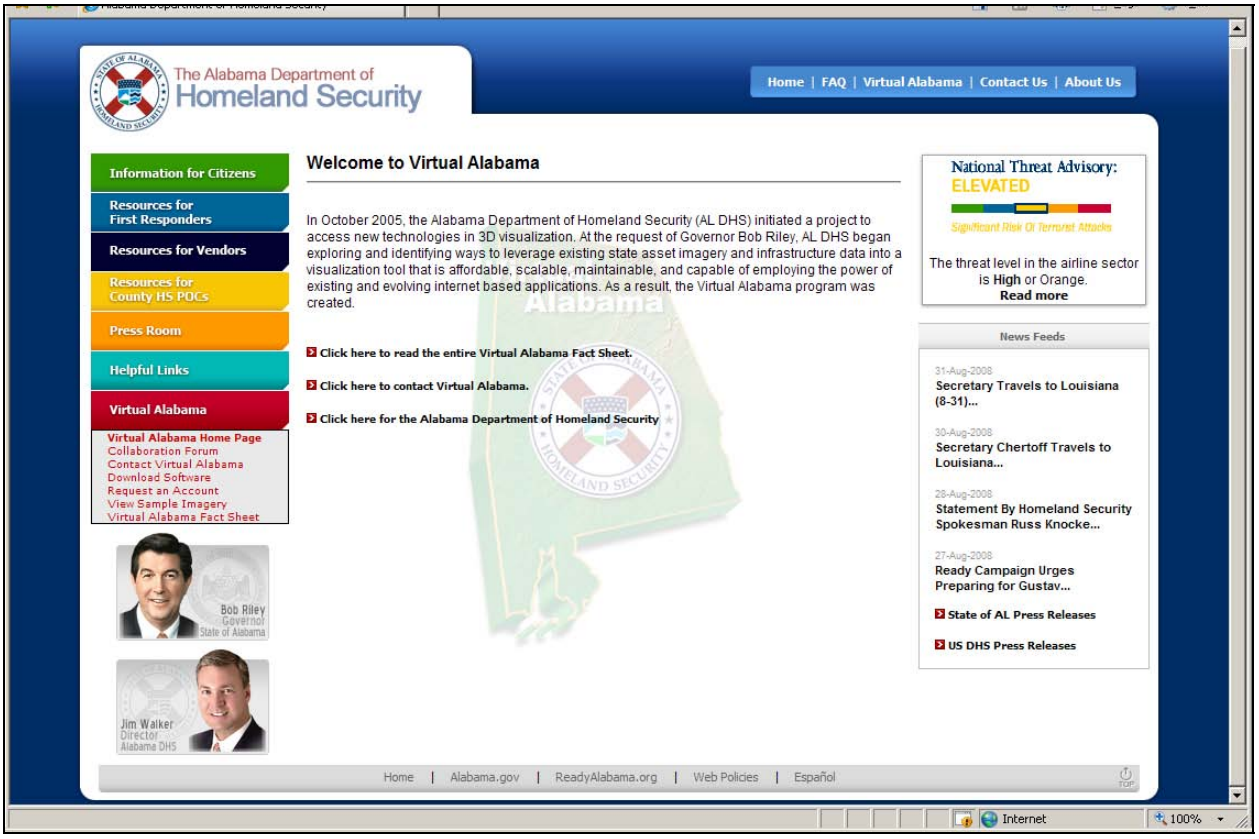
It is difficult for jurisdictions to share and exchange information. Jurisdictions stressed the importance of needing to share data and all types of information through easy-to-use, flexible, and adaptable tools.

In reference to a tool that meets many of these requirements, interviewees frequently mentioned Virtual Alabama as a tool they would like to have in their own jurisdictions.[4] Virtual Alabama uses a three-dimensional interface to retrieve state asset imagery and infrastructure data from a centralized global imagery data set. This data set transforms massive amounts of data into useful information for technical and nontechnical users. As an example, Virtual Alabama provides the common operating picture and situational awareness needed by Alabama's first responders to protect lives and safeguard citizens before, during, and after a disaster. This visualization tool is affordable, scalable, maintainable, and capable of employing the power of

[4] Virtual Alabama is available at http://www.dhs.alabama.gov/virtual_alabama/home.aspx.

existing and evolving Internet-based applications. Figure 2-4 shows the opening screen.

Figure 2-4. Opening Screen for Virtual Alabama



Tracking

When preparing for and responding to a threat, jurisdictions need to track a wide variety of information and, whenever possible or practical, display it on GIS. Table 2-1 lists, for several categories, types of information that need to be tracked.

Table 2-1. Categories and Types of Information to Be Tracked

Category	Types of information
Asset/resource	Location Availability Deployment Demobilization Condition needing repair or replacement Related costs

Table 2-1. Categories and Types of Information to Be Tracked

Category	Types of information
Donations receipt and distribution	Date received Received by From whom For whom Value Delivered to and accepted by Cost of delivery
Financial processes	Implementation of agreements and contracts Requests for critical equipment and supplies Location and acquisition of unanticipated equipment and supplies Responding departments' expenditures for initial debris clearance and restoration of critical key assets
Responders	Initial command-and-response personnel assignments Location and activity Location within buildings and/or underground Amount of time in service Personnel in rest or out of service status Scheduling and assignments for a minimum of 24 hours
Damages/losses	Infrastructure Homes Businesses
Volunteers	Self-service application Web-based activation and assignment Skills and service areas Location and activity
Requests for assistance	Date and time of requests From whom For what When needed Availability and deployment Disposition/demobilization
Victims/casualties	Injured Fatalities Sheltered

Table 2-1. Categories and Types of Information to Be Tracked

Category	Types of information
Location	Missing Reported by Last known location Health condition Description/pictures

Information Dissemination

Communication with the public, both when preparing for and during an event, is a requirement with unique considerations for the ES community. Privacy is one consideration; planners and responders need information on special-needs populations such as non-English speakers, elderly people, handicapped people, transients, prisoners, and others. This information usually can be gathered only via voluntary registration by those with special needs; once collected, this information requires privacy protections.

Political concerns also affect the ability to disseminate definitive information to the public related to (1) what emergency responders can provide under rapidly changing circumstances, and (2) what the public must be able to do for themselves. It is necessary to motivate the pubic to prepare, but it often is politically undesirable to clearly delineate what the ES community can and cannot do in every scenario. There is never just one way to deal with an emergency; each situation requires a unique response to what is occurring at the moment a decision is required.

Interviewees requested tools that will do the following:

- Enable them to disseminate information to special-needs populations
- Allow special-needs populations to voluntarily register for assistance (a self-service application
- Enable them to disseminate information to the general public
  - Static information—for example, plans, information on threats, and self-protective measures
  - Dynamic or real-time information—for example, updates during an event.

INTEGRATION

A number of interviewees noted the requirement for integration of tools. Tool integration refers to the ability to link different software tools so that processes of one tool can work with processes in another tool. One example of tool integration is data exchange, in which a software application has a defined way of passing packages of data elements to another application.

Integrating tools across the ES community is challenging due to the following factors:

- *Differences along discipline boundaries.* Processes, tool sets, and perspectives of law enforcement do not match those of public works, for example.
- *Differences by level of jurisdiction.* For example, processes and tools used in a county are different than those used at the city or state level to support the same capability.
- *Very wide variety of tools in use.* Tools range from contracted services to commercial off-the-shelf software, to locally developed applications, including Microsoft Office tools and Unix-based applications.

Our interviewees frequently used the term “interoperable” to refer to integrated software. They envision interoperable—or integrated—software tools in several ways:

- Standard tool suite
- Stronger communications links between software tools
- Data standards, taxonomy, exchanges, and integration.

Standard Tool Suite

The requirement for a standard suite of tools (a standard tool for each function common to most jurisdictions) came up in multiple interviews. Interviewees specially mentioned the following characteristics that they need in a standard interoperable tool suite:

- Interoperate at all population levels (for small jurisdictions as well as large)
- Extend beyond communications, to all systems and all disciplines
- Have plug-and-play ability that is recognized by the desktop operating systems and is easily installed

- Work in real time during an event, as well as in separate modules for day-to-day use
- Be acceptable to IT departments as well as EMAs/EOCs
- Be developed using a flexible, open architecture in order to work across systems and hardware.

In addition, interviewees identified integration needs regarding specific types of tools:

- Integration of resource inventory databases that can be viewed in real time during an event
- Integration of storm surge data with both flood zone maps and reverse-911 systems
- Integration of surveillance and command/control functions in a single portal, for example, for pandemic influenza
- Integration in real time between EOCs—for visual links, video streaming, and data exchange
- Integration between GIS and other tools, along with information on which tools will integrate with different GIS products
- Seamless integration between different versions of WebEOC (state-level implementations of WebEOC most often integrate county information, but cities and other local jurisdictions require integration as well)
- Invitation from larger jurisdictions for virtual participation of smaller jurisdictions in the daily use of EOC software to share perspectives on planning and response requirements.

Communications

Communications links between software tools are required to support both the requirement for integration and the ability to integrate data between software. This linkage can be either via LAN, wide area network/Internet, or other communications channels. Below are some specific communications requirements:

- Network connections to allow all emergency response satellite locations to participate in training
- A two-way live feed with emergency dispatch center for points of contact in each location in an event

- Wireless connections to integrate computer-aided design data with field assessments to assign and track activities and progress of cleanup/recovery crews
- Satellite communications (to provide redundancy), funded by grants
- Stable communication links for applications; for example, a state-level implementation of WebEOC should include communication and access provisions for local jurisdictions
- Communication and connections to integral non-governmental components of emergency response (such as the American Red Cross), which may require standards or policy changes.

Jurisdictions require large amounts of data and information in order to adequately prepare for and respond to an event. Numerous interviewees mentioned that needed information often either is not available or is not collected. Reasons for this situation might include a lack of resources, time, or funds or, at the time of the response, lack of knowledge concerning what data were needed. Interviewees also noted that for the most part, the collected information and data are accurate, but some information and data are insufficient or inaccurate. Correct information needs to be gathered and placed in a central location for access by everyone. Ideally, this information collection process should be defined, with validation steps to ensure that the data are accurate, informative, and timely.

Once data are collected, they must be stored in centralized repositories so that they are readily accessible. In addition, the user roles, permissions, and access control need to be defined to ensure that the proper resources have read/write access and to preserve data integrity.

Often, access to information has to do with regulations and statutes to which the jurisdictions must adhere, as well as with relationships between and among jurisdictions and between jurisdictions and the governing state. These longstanding relationships, while necessary and crucial to the EM process, need to be studied further to strengthen the communication process so that the flow of information is streamlined. When access and visibility to information is improved, the relationships between jurisdictions will improve as well.

Data Standards, Taxonomy, Exchange, and Integration

Providing a standard tool suite and strengthening communications links are not sufficient to integrate software applications. The data flowing between applications must be interpreted correctly to be of use. This requires standardized definitions or a shared taxonomy (taxonomy includes relationships among the terms defined). Data exchange standards will provide definitions of “packages,” composed of agreed-upon data elements, and each element’s definition will conform

to a standard vocabulary or taxonomy. When data standards such as these are in place, true integration can take place.

The need for models and other tools to integrate, or at least exchange, data easily is universal; nearly every jurisdiction that uses software has requirements for data standards, exchanges, or taxonomy. The following are samples of interviewees' requests:

- A data exchange standard for electronic tracking of resource expenditures for all response agencies
- A nationwide standard for EM taxonomy and data exchange so that various tools/software can transmit data between tools created by different vendors (or for tools developed in-house)
- At the FEMA region level, a standard on critical data exchange throughout the region or standardization on a specific software application.

Standards for Data

Data standards are needed for overall data exchange, EM taxonomy, and regional critical data exchange.

Interviewees also mentioned requirements for integration of specific types of data or specific applications. One common theme was geographic information; jurisdictions require data that are easy to integrate on simulated maps:

- Integrate plume data from CAMEO with GISs
- Integrate hazardous materials data (for example, Environmental Protection Agency Tier II data) with GISs
- Integrate GISs with reverse-911 tools.
- Integrate facility plans of buildings with GIS
- Integrate property valuation data with GIS for estimating damage and losses.

General data integration needs were universal; every interview included some reference to integrating some application or data, such as the following:

- Asset tracking software that can exchange data with WebEOC and be consistent with the National Incident Management System.
- Software that can capture data, at the most granular level of detail, to support later aggregation of the data in various ways. An example is post-event accounting; jurisdictions must ensure the availability of all pertinent data to prepare a governor's request to the President for a disaster declaration. However, a governor often does not know—before the event—exactly what data will be needed for that request.

- Capability to tie form data and information between the localities, the state, and FEMA (while also taking into account budgeting, funding, thresholds, and the like at all levels). Navigating the bureaucratic paperwork and workflow should be easier.

- Capability to integrate data across all tools—not just GIS—to address all critical elements required for event management.

- Capability to assess all tools and models to determine if their outputs can support exercises and training simulations.

- Capability to integrate data capture and reuse the data.

USABILITY

Usability measures the quality of a user's experience when interacting with a system such as a website, a software application, or any other user-operated system. Usability also refers to how well users can learn and use a product to achieve their goals and how satisfied they are with that process. Usability may also consider such factors as cost-effectiveness and usefulness.[5]

To be usable and adaptable for the ES community, models and tools should have the following characteristics:

- Easily accessible through a simple download/install process

- Compatible and easy to integrate with other commonly used software

- User friendly, with limited technical support required

- Easily support the multiple modes of operation: networked, without network connections (standalone or LAN only), and without electrical power (laptop or hard-copy only).

The characteristics above are examples of requirements for models in this community. The following are other important characteristics for the models:[6]

- *Easy to learn.* In jurisdictions with limited resources and technical support, how quickly can users teach themselves to use the model and its outputs?

- *Efficient to use.* Once users have learned to use the model, how fast can they accomplish tasks?

[5] See http://www.usability.gov/basics/whatusa.html.

[6] See http://www.usability.gov/basics/whatusa.html.

- *Memorable*. Once users have used the model, can they remember enough to use it effectively the next time, or do they need refresher training?

- *Error proof*. How often do users make errors while using the model, how severe are these errors, and how do users recover from these errors? For example, when a user updates the model during an event response, the model should provide the necessary validation and feedback to prevent erroneous entry.

Models need to be simple to navigate, be intuitive, and enable the user to interact with the model efficiently. Models should be created with the guidance of ES subject matter experts; this group should include those with experience in both operations and crisis decision making. Often, models for the ES community are created by people who are outside of the community and therefore have a limited view into how the models will be used day-to-day. In fact, many of the existing models are not designed to be used beyond the preparation phase. Without daily use in normal operations, users will not achieve a level of comfort with these necessary tools.

Usability

There are two types of users in the EM community: the actual application user, and the decision maker using the output of these tools. Easy-to-use, flexible, and adaptable tools will provide the necessary information and output for decision makers to make key informed decisions.

Because responders are one part of the total community response capability, the output must be clear enough for elected and appointed leaders to arrive at critical decisions that only they have the authority to make. The proposed suite of tools should be able to reliably trigger points requiring an executive decision and provide data to augment the development of viable options. Survivability is also important to the applicability of any model to the ES community. In order for models to be of any use, they must be designed to support users during various modes of operation. Users must operate at peak efficiency under disaster conditions. Models should support both automated and manual use, ranging from normal operations (non-disaster), to complete lack of connectivity requiring the use of paper and pencil. As a result, the models designed to serve these users must take into account all the domain-specific requirements not typically encountered by software development efforts.

Chapter 3
Operational Requirements

Operational requirements describe the operational conditions and support that must be in place if the entire system—people, processes, software, and so on—is to work successfully. Many operational requirements are critical to the successful adoption and operation of the models and other tools needed by the ES community. This chapter addresses the operational requirements that are not directly linked to one specific function or specific requirement. The operational requirements are grouped as follows:

- Coordination and culture
- Guidance, standards, and information
- Processes and interoperability
- Political issues, policy, and statutes
- Funding
- Education and training.

The following sections provide an overview of these requirements, synthesized from the information obtained during interviews. Appendix D contains the complete list of operational requirements identified by our interviewees.

COORDINATION AND CULTURE

Coordination

Coordination is defined as the cooperative activities and information exchange intended to improve area-wide operational capabilities. Many barriers to coordination exist. Sometimes coordination is inhibited by cultural differences; and sometimes by legal boundaries (for example, coordinating resource sharing across state boundaries). One way to categorize coordination challenges is according to the boundaries across which coordination is inhibited: within a jurisdiction, with other jurisdictions, and at the regional and national levels.

Boundaries

The evolution of emergency management from traditional disciplines has resulted in "silos" of data, information, and processes. These boundaries hinder efficient communication and collaboration among the disciplines.

Coordination within a Jurisdiction

Coordination within a jurisdiction is difficult across disciplines or groups. The boundaries between disciplines are so ingrained that most EM training and documentation is organized according to discipline. Even emergency support functions are divided along discipline lines. This contributes to the differences in vocabulary, perspective, and approach in each discipline and can result in separate data sets, incompatible data, and the like.

The following are key operational requirements necessary to support inter-organizational coordination within a jurisdiction:

- Approaches or methods for involving all disciplines (including public works and transportation departments) for transportation and evacuation modeling
- Approaches and methods to easily and effectively engage all planning and general information sharing across all disciplines
- Guidance on how to properly involve all the disciplines in defining and using GIS layers
- A process to share information related to all human resources across disciplines
- A process for coordinated deployment and tracking of responding personnel from all disciplines.

Coordination with Other Jurisdictions

Coordination with other jurisdictions is difficult. Differences in policy, perspective, and priorities, as well as levels of authority, can all create barriers to successful coordination.

Coordination

Coordination challenges exist *within* jurisdictions, *between* jurisdictions, and at the regional and national levels. Each of these coordination challenges must be met for successful emergency planning and operations.

Interviewees suggested key operational requirements that include providing approaches or methods to do the following:

- Develop a common operating picture across response agencies and disciplines during response
- Implement EOC software across jurisdictional boundaries, for example, illustrating how larger jurisdictions with EOC software could invite participation and allow smaller jurisdictions daily access to EOC software for planning, retention of training, and ease of use during an event or incident

- Track all requests for assistance and donations, regardless of their origination, and track disbursement of all donations including funds
- Link up with those who have expertise and resources for dealing with special populations (including prison populations)
- Establish agreements with educational institutions (like community colleges) for training and education, with options for waiving tuition for emergency services personnel.

COORDINATION AT THE REGIONAL AND NATIONAL LEVELS

The following are key operational requirements to enhance coordination and consensus at the regional and national levels:

- Guidance at the federal, FEMA region, state, and local levels on data and information sharing
- Documentation (after-action reports, exercises, and simulations) that is consistent nationwide and is locatable and usable by others
- Maintenance of casualty estimation studies and other casualty information (even anecdotal) in a national clearinghouse.

Culture

Culture reflects both perceptions and practices of a specific group. Cultural differences often exist between disciplines, jurisdictions, levels of government, and within government conglomerates of merged agencies. These various cultures often prove to be inhibitors of coordination, progress, change, and innovation, and they affect the open exchange of critical information.

During a crisis, the emergency response community is tight-knit; for example, resources are often shared between jurisdictions. Helping one another is second nature, and for emergency responders, rolling up sleeves and "doing" is the most natural action. Most communication occurs person-to-person; within a jurisdiction. In smaller jurisdictions, everyone knows everyone and things get done over the phone or in meetings. Most planning coordination occurs in meetings in which people tend to use their experience and the experience of others as data and input into planning and exercising. However, cultural differences may also be reflected in the individual disciplines' plans.

Operational requirements specifically related to programmatic components of the EM community and universally to the ES culture include the following:

- An integrated process to define the roles of the disciplines, the key responsibilities, and both the shared and the role-specific privileges of operations management software.

- Expanded use of computer tools that will assist with integrating the preparedness efforts of multiple jurisdictions and multiple disciplines and that will promote the establishment of a culture of sharing.

- Communication links between jurisdictions regardless of population and resource size.

- Decision support information from a trusted source in this community. If the models and their outputs are to be trusted, the inputs to the models and the models themselves must be trusted by the users.

- Models and tools provided must be built *with* the users, and they should be able to see the provenance of the models and the data.

A key theme of these requirements is the need for software that is compatible with the various disciplines of the EM culture. Many interviewees mentioned that the software being used by the ES community does not support the way ES personnel plan and respond to events. To ensure the successful use of software in the ES community, the software design must consider the strengths of the different disciplines and areas of expertise. The software needs to be flexible and accommodate all aspects of the ES culture; otherwise, it will be difficult to obtain user buy-in, and it will be difficult to obtain adequate support from the executive leaders. Through the use of groups, roles, and privileges, these different areas can be represented in many software applications.

Culture

Cultural differences often exist between disciplines, jurisdictions, and levels of government and within government merged agencies. This inhibits coordination, innovation, and exchange of information.

Because the EM focal point is often at a larger jurisdiction, smaller jurisdictions receive little guidance or assistance with selecting and implementing information technology. As a result, the software selected by smaller jurisdictions often has no capacity or capability to share data with other jurisdictions. Sharing is crucial when an event requires multiple jurisdictions—either at the same level or at multiple levels—to prepare and respond together.

Communication among jurisdictions of similar size and resources is important to stay current with the latest information, trends, state-level news, and best practices. Larger jurisdictions, which usually have more resources, could easily encourage, promote, and share perspectives on preparation and response requirements by inviting virtual participation of smaller jurisdictions in the daily use of EOC software on a broader metropolitan basis rather than just jurisdictional. This fosters cooperation and understanding among jurisdictions in a state and provides a means of communication should the need arise during an event.

The broad-based ES community must have trust in the information they receive, the source of that information, and the reliability of the software. Planning and decision making is crucial in the various ES disciplines; a decision can either save

or cost lives. Trust in the source of information is a main concern for interviewees. Presently, most information they trust comes from personal contact, but as information sharing becomes automated, they want assurance that the information comes from trusted sources.

Emergency planners are challenged in today's world because of the complexity of disasters and the frequency with which emergency response personnel are deployed. The ES community increasingly needs automated solutions that will allow better communication and sharing of critical information between and among disciplines and jurisdictions; assist ES personnel with planning for events; assist personnel with dealing with a wide variety of populations, particularly populations with special needs (elderly, disabled); and allow for smaller jurisdictions to interact with their larger counterparts in order to share perspectives and exchange ideas regarding planning and response needs.

GUIDANCE, STANDARDS, AND INFORMATION

Guidance

The term "guidance" here refers to the general approach that has been developed to assist planning efforts and that can be tailored to meet individual needs. Numerous sources of guidance exist for both EM and ES personnel at the federal, state, and local levels. However, no single authoritative source of all guidance exists. The following are operational requirements identified by our interviewees:

- An authoritative source for guidance and a regular review process to ensure that they remain viable and up to date
- A mechanism for the ES community to request specific needed guidance, such as how to develop MOUs that cross state boundaries
- For states, assistance with the development of guidance that can be applied statewide to promote consistency among programs and IT services
- At the federal level, clear differentiation between what should be regarded as "guidance" and what constitutes "standards."

A gap exists in the guidance concerning legal and statutory barriers to sharing resource information across state boundaries. Interviewees in jurisdictions bordering other states stated that MOUs are needed with the neighboring jurisdiction in the adjoining state to facilitate collaborative planning, sharing of resources, and exchange of critical information. Interviewees noted the difficulty in putting these MOUs into place, citing long-standing laws and regulations as the primary reasons why the MOUs could not be established. Other interviewees expressed the need for more MOUs and for strengthening and updating existing MOUs.

Guidance for MOUs is needed. Specifically, interviewees have requested templates and sample MOUs for different organizations and agreements. Although sample MOUs are available from a variety of sources, the ES community needs an authoritative source for templates along with guidance on their appropriate use that reflects some level of legal review and counsel.

Information protection and privacy concerns are a big issue with ES preparation and response in the current environment. The existence of multiple sources of applicable guidance, of privacy issues such as those addressed in the Health Insurance Portability and Accountability Act, and of other various privacy-related legislation creates a confusing information protection environment. The ES community needs a central location for authoritative guidance for information and data protection, both for privacy and other types of information protection.

Another area of concern to interviewees relates to a need for guidance on software development and IT project life cycles. They were unaware of the numerous software development life cycle (SDLC) methods available, such as the methods promulgated by the Software Engineering Institute and the SDLC standards issued by the National Institute of Standards and Technology. In addition, interviewees said they need procedures for coordinating with their local IT departments, as well as software acquisition procedures at the local level. Even when guidance and procedures exist at the local level, they are almost always different than those of neighboring jurisdictions. Guidance and procedures exist in some states, but may not be provided or used at the local level.

A simple way of discovering best practices vetted by their peers would be of great use to the ES community. Best practices not only would be useful for ES processes, but would also be extremely helpful when implementing IT solutions. For example, private entities, such as stadiums and the entertainment industry, use commercial software packages as part of their nonemergency planning for security, crowd control, and other aspects of event management. These software packages can also be used by EM personnel to plan for similar types of events. By regularly using event management software or similar types of modeling tools for normal operations, EM and ES personnel could gain proficiency in the use of these tools for emergencies.

Policy and procedural guidance standardization is another area of concern to interviewees. The guidance is often too high level, outdated, or simply not applicable to present-day conditions, posing challenges for ES personnel. In addition, guidance in one jurisdiction may conflict with that in other jurisdictions, even within the same county or state; such conflicts make preparation and response difficult. Interviewees expressed the need for policymakers to issue accurate and consistent guidance and also to differentiate between what should be accepted as guidance and what should be considered a standard requiring a certain level of compliance.

Standards

The multidisciplinary ES community uses the term “standard” to describe a number of things, from the principles and practices of certain disciplines, to detailed technical specifications. In this report, the term “standard” refers to processes, data elements and their definitions, and software.

Interviewees expressed a need for standards for the following items:

- An authoritative source to identify standards in effect along with a regular review process to ensure that they remain viable and up to date
- Criteria and credentials for ES personnel
- Asset tracking
- Response resource estimating
- Regional software and data exchange
- MOUs
- Information and data protection
- Data interoperability
- Software compatibility
- Open software architecture.

Standards for some of the above items already exist or are under development, but interviewees were either unaware of them or are concerned about implementing them without having some confidence that all jurisdictions and disciplines would be using those same standards. The first three items are being addressed by FEMA’s National Incident Management Systems Integration Division. Specifically, the division’s National Integration Center (NIC) is developing a national credentialing system and resource-typing standards. The NIC website also has a Mutual Aid page that provides samples of mutual aid agreements and shows the linkage to the standards for resource typing. Partnering between DHS/S&T and the FEMA NIC would ensure that standards are stable before they are implemented in resource estimation or asset tracking software.

To enable sharing of personnel resources across jurisdictions, interviewees requested a standard credentialing system at the national level that uses consistent criteria to award standard credentials and titles in the ES community. Interviewees also understand the need to invest in asset management systems; however, because they need to share asset availability across boundaries, they need a standard for both the description of assets and for data exchange. Related to this is the need

for a set of standard estimating tools much like the Target Capabilities List that supports standard estimating for the NPSs.

Interviewees believe that some opportunities exist to leverage efforts by individual states and other jurisdictions within a FEMA region. This is especially true when multiple jurisdictions have implemented the same vendor's software. If the software is networked and licensed properly, it could be extended or expanded to support all jurisdictions within a state or even the entire region.

Interviewees urgently requested standards for data interoperability of all types, especially for GISs. Lack of standards in this area hinders mutual aid and regional response, as well as long-term investment in robust GIS-enabled systems.

Guidance

A single authoritative source of guidance should exist for all personnel to follow in areas such as sharing information across state boundaries, information protection and privacy concerns, software acquisition and implementation, best practices, and standardization of policy and procedural guidance.

Software compatibility is another key issue. Interviewees noted the need for a standard for software compatibility, so software can be certified as interoperable. At a minimum, software from the same vendor must be compatible across versions. Currently, jurisdictions in the same state have bought the same software, only to find it was incompatible due to differences in version. In addition, some jurisdictions have requested a standard that stresses using a flexible open architecture for all software. These jurisdictions typically are sophisticated in their use of information technology, based on partnerships with local universities or technology firms.

Some standards that apply to the ES community have been issued by the Organization for the Advancement of Structured Information Standards (OASIS). The following are examples:

- Common Alerting Protocol
- Emergency Data Exchange Language Resource Messaging
- Hospital Availability Exchange.

The second has an immediate impact on some of the functional requirements (for asset management tools, for example). This community would benefit from DHS guidance on the application of these OASIS standards and products from other standards bodies in their IT applications.

Information

EM and ES personnel need many different types of information when preparing for and responding to events. They also need to disseminate information during the response phase. Identifying the specific data needs—such as regional response

assets, resource availability, and updated weather information—is key to effective and efficient response. This information needs to be centrally located for easy and immediate access by all personnel.

Information also needs to be created and disseminated to the public and coordinated in advance with executive decision makers. Challenges in this area include how to best educate the public with respect to planning, personal planning requirements, and special populations and privacy concerns. This information is difficult to gather and document and often cannot be all-encompassing to serve all facets of the public, due to the many different populations that require this information. Interviewees expressed the need for automated solutions to assist them with creating and maintaining public information, as well as better ways of disseminating the information, such as using the phone book as a place to communicate to the public about personal preparation and standard response procedures.

Information
The ES community needs not only to have immediate access to information, but also to disseminate this information quickly to decision makers and the public.

Another key set of data needed by the ES community concerns assets, including resource estimates. Assets are managed and tracked in different ways ranging from manual processes to integrated logistics systems. Therefore, it is difficult to identify the assets available to support a regional or a multi-jurisdictional response. Because no standard exists for asset management data, it is difficult to exchange this type of information efficiently. Information on assets needs to be available and tracked for accountability purposes, so that personnel can have an idea as to what is available and what resources have been expended.

Information gathered during the preparation phase, such as population and address information, should be available and shared across all disciplines. Information sharing among various disciplines is paramount to response success. In addition to coordinating during an event, personnel also need to prepare collaboratively to ensure that they can deal with all types of events. Central access to and sharing of information are important aspects of this process.

PROCESSES AND INTEROPERABILITY

Processes represent a progression of general steps needed that can be modified to achieve an objective. Interviewees need processes that are flexible, adaptable, and changeable during both preparation for and response to an event. For the most part, interviewees did not ask for standard processes, but they need good processes that they can adapt for local use. Standardized processes will not fit in this community, because at the local level, all processes must fit the jurisdiction's conditions at a given time. In other words, no single standard process will fit unless it is adapted so much that it is no longer "standard." There seems to be a common evolution from "process" to "standard" indicated by interviewees, that

can occur over time or may also be event driven, to control actions such as eligibility for federal funding.

A common requirement is for a consistent process to capture response data during an event. The EM community can then use those data to satisfy other needs such as analysis, development of training exercises, reporting, and retention for future needs. Better analysis of response data would enable comparisons across response efforts. However, jurisdictions need a process for evaluating event response results and a method for using large events, such as concerts, as input to create training and exercise plans. Interviewees also noted the need for specific ways to automate the retention of historical data for use in estimating future response needs for events.

Processes and Interoperability

The ES community needs tailorable processes, and the supporting systems should interoperate and share data to achieve a true common operating picture.

Although every event requires adapting the plan to event conditions, having a repeatable process enables a lot of efficiencies in multiple areas such as planning, budgeting, training, and resource assignment. Near the completion of the response phase, efforts should transition to the recovery phase. However, interviewees noted that they have no processes for making a smooth transition or for accurately assessing the recovery phase.

Interviewees would like a sample process for local tracking of assets for accountability; however, that process is dependent on the existence of not only stable data requirements but also a stable federal policy for funds reimbursement. For example, a response effort that has begun before a policy change at the federal level has taken effect should be subject to the original federal policy that was in effect at the start of that response effort.

The above requirements also suggest that further process improvement is needed in other key areas. Interviewees need a change management process specifically oriented toward emergency management. Such a process would enable them to ensure that lessons learned are applied and that response plans and actions are improved.

Most interviewees said they have limited IT support and need processes to manage IT more efficiently. ES personnel would like to leverage their peers' experience with implementing software, and they need a process to do that. As an example, they mentioned a state software council; they requested a process to organize a similar body at the regional level. Because a jurisdiction's processes must "fit" its characteristics (size, funding, geography, etc.), interviewees need a way to locate and share information on IT solutions with jurisdictions that have similar characteristics.

The trend toward common processes should, over time, enable both consistent definitions of data and greater interoperability between systems. Jurisdictions' interoperability needs should be combined with process improvement

requirements to discover relationships between these sets of requirements. Interoperability requirements include real-time access to current data across jurisdictions, disciplines, and systems. For example, during a flood, evacuation modeling during the response phase requires GIS, updated threat data (flood levels), and traffic data. In addition to the technical challenges, the operational requirements for agreements, and negotiating conditions for access to data, must be addressed.

Operational requirements related to asset tracking include barcode readers and systems. However, before implementing an asset tracking solution, many questions, such as the following, must be answered:

- Will there be a nationwide standard for these systems?
- Will there be a data exchange standard?
- Should emergency managers attempt to coordinate such systems with NGOs or work solely with other government jurisdictions?

Using proven IT implementation methods, the nationwide ES community can reach consensus on requirements, both functional and operational, related to an asset management solution that will meet its interoperability needs. A common concern was that information entered at the local level became irretrievably lost in the federal system and had to be resent, sometimes more than once.

Achieving a common operating picture is a difficult undertaking, requiring integration of GIS, asset management and resource tracking, and many other applications. It is so critical to "see" equipment and personnel status, jurisdictions are willing to work toward a Common Operating Picture (COP) using any technology available. Whether this is done through videoconferencing or other technology, implementers need to know what they must consider when planning and implementing the solution. Guidance in the process of developing infrastructure for a COP would save much effort and would provide a defined path to achieving the goal.

In some cases, operational requirements may prevent satisfying some functional requirements. Interviewees requested that the various forms required by state and federal agencies and NGOs all use consistent data elements, with the same format and definition. This functional requirement depends on consensus among all of the pertinent organizations. This operational requirement may be difficult, and take a considerable amount of time, to satisfy. An alternative might be to ensure that any accepted system has the ability to mine the various forms for critical data elements.

POLITICAL ISSUES, POLICY, AND STATUTES

Political Issues

Political issues are similar to policy issues, in that they require decisions above the operational level and can be influenced by internal and external forces. In EM planning, it is essential that potential extraordinary situations be considered, particularly in light of major events, such as Hurricane Katrina and Hurricane Rita, during which the political aspects dominated the situation more than the event response did. Mistakes are more likely if plans are incomplete or outdated, if procedures are not followed, and if responsibilities and authorities are not clearly understood.

Political Issues

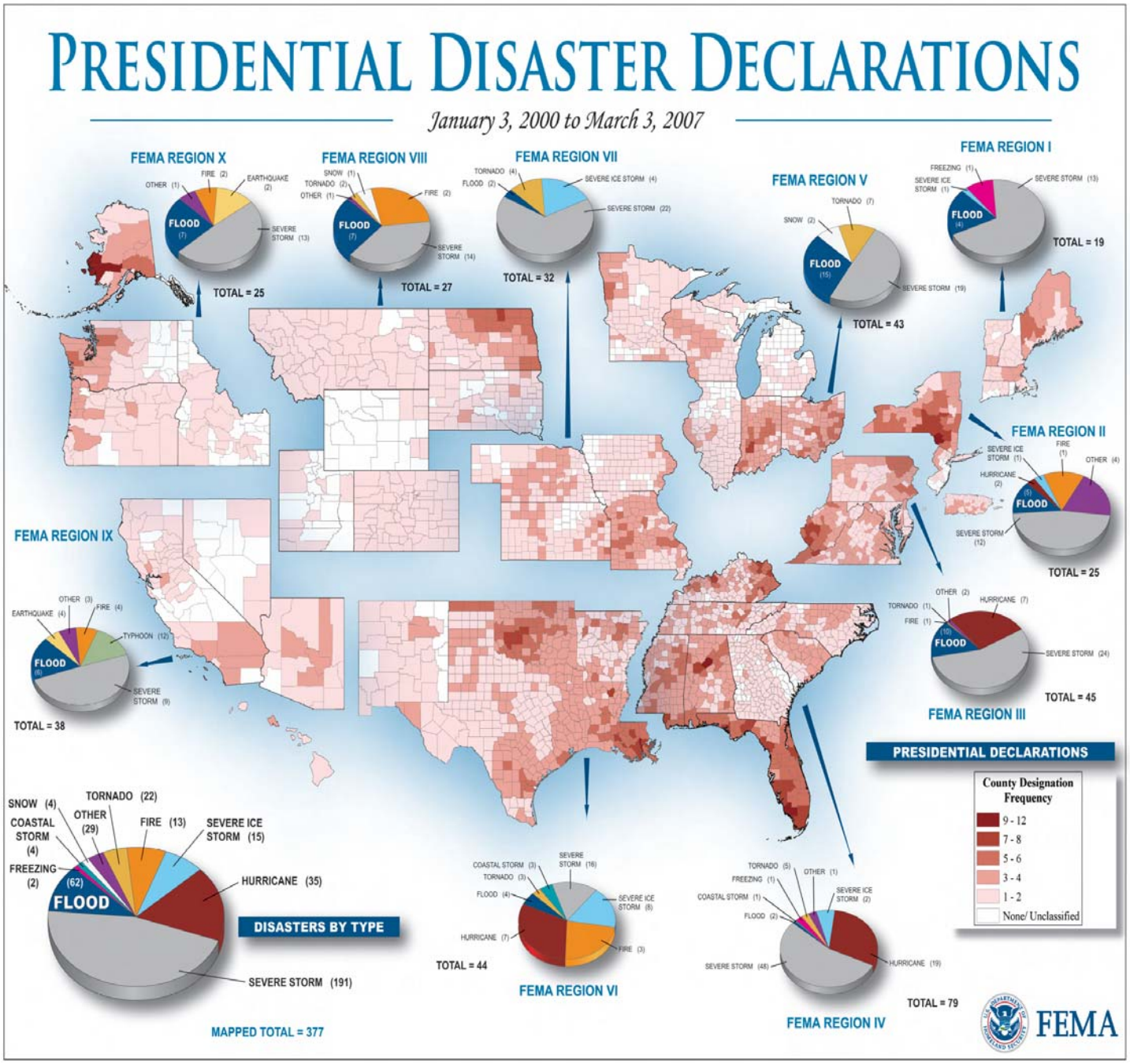
Political issues and their ramifications need to be dealt with case by case. Having effective communication with the public, ensuring that executives are briefed on pertinent information, and improving overall communication are ways to navigate through these issues.

In major events such as catastrophic disasters with mass casualties, EM preparation and response estimates must be as accurate as possible. EM planners have difficulty engaging the entire community, especially elected officials, to plan for scenarios beyond what a jurisdiction can handle or to project estimates beyond a jurisdiction's capability to respond. The reluctance can stem from political sensitivities to potential negative outcomes. This greatly hinders EM planning, because to accurately estimate budgets and resources for upcoming years, planning and response requirements need to be communicated as accurately as possible.

Understandably, elected officials and business interests want to cast their community in the best possible light in order to attract businesses and residents to the area. However, no location is risk free. In this respect, a dynamic EM program can be a positive note in areas that have a particularly high level of risk. Even in areas that seldom experience a major disaster, the community wants to know that it is protected from the consequences of the most probable threats, such as wildfires in rural areas. In every community, people want to know how they will be protected and when they can resume their normal activities.

Figure 3-1 shows the frequency and types of hazard events that resulted in Presidential Declarations from 2000 to 2007. It is not possible to live in an area that is totally risk free. Many areas have not required a Presidential Declaration but are still subject to potential catastrophic events.

Figure 3-1. FEMA Hazard Map



Issues raised during interviews related to the lack of leadership, differences in political views, competing priorities, and the lack of a cohesive community approach. These factors contributed to politically motivated decisions that affected program funding, local planning, collaborative planning with adjacent jurisdictions, and the dissemination to the public of information related to government responsibilities and the public's roles and responsibilities.

Operational requirements for managing political issues include development of processes and procedures to do the following:

- Communicate the level of risk to the public
- Encourage and assist both residents and visitors in protecting themselves during and following a disaster
- Brief new executive and appointed officials on
  - the roles and responsibilities of their positions under disaster conditions,
  - the need to communicate with federal and state disaster agencies for informing them of conditions and requesting funding assistance,
  - the nature and scope of the emergency planning and response capability of the community,
  - the availability and activation of external resources if needed, and
  - the general level of threat for the area
- Engage the business community in the development of community action plans to assist and protect businesses
- Communicate, to the public, plans for the resumption of essential government services and businesses as quickly as possible.

If satisfied, these operational requirements will enable better planning and preparedness by both jurisdictions and their citizens. They may also reduce the number and nature of political decisions that, if made under stressful conditions, could adversely affect response and recovery.

Policy

A major issue expressed by interviewees in local jurisdictions is that policies governing their programs change too abruptly or too frequently. These policy changes, whether federal or state, may make sense at the level where they originate, may support fiscally responsible practices, or may align with a new mission or vision. However, they also may affect the continuity of services at the level of the responder community. Other policy issues raised and resolutions suggested by EM personnel affect the broad spectrum of operations—from administrative and EM processes and tools, to information technology, to funding and budgeting.

FEDERAL PROGRAMMATIC AND DISASTER RESPONSE POLICIES

Federal policy changes affecting the EM community take place more frequently than the community can absorb, and their impacts can be significant. Most often, this has to do with eligibility for federal funding following a disaster, but sometimes occurs in relation to the annual funding process for the various federal programs such as the Emergency Management Performance Grants and Urban Area Security Initiative (UASI). The changing policy landscape sometimes hampers both preparation and response; responder organizations cannot develop a plan with confidence that, at the time of execution, their response actions will be in accordance with the policy. This also negatively impacts the confidence the public has in the willingness and ability of the federal government to act quickly and responsibly when disasters occur.

Jurisdictions are not required by federal law to participate in FEMA's EM funding program, but if they choose to do so, they are required to share costs. However, conflicts arise due to disconnects between the federal funding process and the jurisdictions' budget processes. The federal program regulations are generally not provided far enough in advance for local jurisdictions to work them into their budget for the upcoming year. The local, state, and federal budget processes are very much out of sync. The result is an expectation at the federal level that components of the programs should be in place a year before many jurisdictions are able to budget the matching funds. Consequently, progress in the federal programs then lags due to local budget processes, and Congress becomes dissatisfied with the lack of progress. These policy changes—especially financial policies—affect all aspects of emergency management, because grant funds are constrained by these policies.

Policy
Policy changes are abrupt and too frequent, and they are inconsistently applied from region to region. Federal policy decisions need to be effectively communicated with ample time for compliance.

Interviewees mentioned that federal policy decisions often seem to be made in isolation, with little input from those affected by the decisions. In addition, there is a great deal of frustration when such policies are required to be retroactive, especially when a jurisdiction is well into disaster response activities. For example, during the transition from response operations to recovery operations in a flooding disaster, eligibility requirements were changed, disallowing funding for recovery and restoration that had been eligible in previous declared disasters. Interviewees also expressed concern that such policy changes are not consistently applied from region to region.

POLICIES ON PROCESSES AND TOOLS

In addition to the policy requirements cited above, interviewees mentioned other areas in which policy changes could help their operations. Some of these relate directly to their ability to use models and tools for preparation and response, and others simply streamline some of their operations, freeing up resources that could

be applied to preparation and response. Specifically, interviewees requested the following:

- Policies that support collaborative planning, risk-based funding, and processes or methods to resolve inter-jurisdictional differences of opinion and to address political issues
- Policies to ensure funding for maintaining up-to-date risk analysis in order to plan adequately
- Policies pertaining to grants management reflecting a nationwide EM approach that integrates capabilities and resources of federal, state, and local organizations
- A set of programmatic and technological standards that would simplify the acquisition of interoperable information technology.

Policies
Better policies are needed for processes and tools, collaborative planning, risk analysis, grants management, technology standards, IT acquisition, funding and budgeting.

Not all policy issues are federal. Often, local policies are an issue, particularly when the policies were developed many years ago. The historical policy that established first-responder organizations has not kept pace to include and support the necessary response scenarios. One such change is the shift of the first-responder organizations to address an increasing number of low-risk/high-impact scenarios such as terrorism or the NPSs. Because of the lack of up-to-date policies to support these crucial efforts, organizations struggle to prepare. In addition, in local jurisdictions where disasters occur infrequently, the need for funding is generally outweighed by other competing priorities, leaving the EM organization minimally funded and understaffed.

IT-Related Policies

As the ES community has matured with respect to technology and the support it requires, policy again has failed to keep pace. Interviewees stated that with respect to technical support areas, organizations need to consider the entire software life cycle. Current policies fall short by addressing only the acquisition phase, leaving out operations and maintenance and other phases of the IT life cycle. The following are specific operational requirements relating to IT:

- Life-cycle support of computer systems—hardware, software, and communications—and IT staffing and training
- Federal policies that provide both initial funding and ongoing maintenance of systems purchased through specific programs ensuring allowable expenses under UASI or other homeland security programs.

Interviewees also noted that policies related to information technology do not require compliance to any set of standards for data. As a result, organizations may be unable to effectively implement and manage an integrated system incorporating communication, GIS, and data-dependent models and operational processes, much less interoperate with other jurisdictions. Interviewees need mandated standards for all software used throughout the ES community. The following are some specific operational requirements in this area:

- Policies to encourage and support vendors that guarantee maintenance of existing capabilities and to discourage arrangements with vendors that are constantly releasing new versions or building new products with few substantive improvements or enhancements
- Federal and state policies to support the development of standards to
  - ensure consistent grant processes;
  - assess current capabilities; and
  - identify functional requirements for the acquisition of IT systems and software, systems interoperability, tracking, mobilization, decision support, and record keeping
- Policies at all levels for data management and administrative processes
- Policies to support regular training and exercises for all response personnel
- Policies to ensure continuity of purpose and executive support from administration to administration.

FUNDING/BUDGETING POLICIES

Interviewees identified the need for FEMA, the Department of Health and Human Services, and other funding agencies to standardize on data requested for budgeting and accounting from localities of all sizes. They would like grants processes and forms to be standardized across all federal agencies, to ease the burden of completing the numerous application forms from various federal agencies. This ties in to the functional requirement for a universal data set that can capture and store all the common data, thus requiring additional input to address only the unique requirements for any particular funding source.

Finally, interviewees noted the need for consistency across funding agencies regarding in-kind services. Depending on the grant, local services may or may not be counted as part of the matching funding. Interviewees need a federal policy that addresses and recognizes the local funds commitment as a portion (in-kind) of the cost share requirement.

Statutes

One of the factors that can adversely affect response operations across state lines, principally in communities near the borders, is the lack of acceptance (especially among health care providers) of a state's certifications or licenses by other states. Interviewees strongly believe that states must statutorily establish both the authorization to accept licenses and a regulatory process to do so. Once such a statute is established, a computer tool could be developed to track all certified and licensed responders coming into the state from another state.

Interviews also believe they need a statute addressing the sharing, with other jurisdictions, of information on the availability of resources. In some cases, policies do not allow information sharing across disciplinary lines and especially not across jurisdictional lines. Developing appropriate statutory language would require the input of responders and emergency services officials regarding what information could be shared, under what circumstances, and through what process. Again, computer tools could be beneficial for managing such exchanges through the assignment of privileges within the system. Such a capability would enhance the total operational response without compromising sensitive information.

FUNDING

During the interviews, it became very clear that funding is one of the most critical factors affecting all aspects of emergency management. Nearly all interviewees stated that funds overall are insufficient to support a nationwide emergency preparedness and response system at all levels. The following are some of the compounding factors:

- Funding is shared among federal, state, and local jurisdictions.
- The amount of paper work to apply for and report on funding—required of all local jurisdictions, regardless of size and staffing—is daunting.
- Funds are passed through state EMAs to counties, rather than going directly to qualifying jurisdictions, including cities.
- DHS priorities are often not the priorities of the local jurisdictions.
- The priorities of counties and subcounty jurisdictions may differ.

Local jurisdictions believe they fulfill the requirement for shared responsibility for funding through the emergency services they provide day-to-day, such as police, fire, and medical services. They believe the cost of such services should represent their match for federal funding, allowing them to more adequately and fairly fund an EM program that would meet jurisdictional priorities, as well as those for a nationwide planning, preparedness, and response capability. As it stands, the benefits of receiving federal funding can be outweighed by the

matching funds requirement and the amount of time and effort required to keep up with the administrative work. In addition, a common issue stated by city representatives was that funding should come to them directly without being diminished by being filtered through the state and the county. One drawback to doing so is that coordination among jurisdictions and levels of government is less likely to take place.

Federal funding regulations also significantly affect the acquisition and use of computer tools, due to the lack of the following:

- Leadership in establishing equipment and software standards for interoperability
- Standards for evaluating software applications
- Funding for ongoing training
- Funding for maintenance costs
- Funding for database development
- Funding for proficient IT personnel.

On the local level, major technology purchases are often not considered priority expenditures when compared with other types of ES equipment. Interviewees identified the need for funding for the following items:

- Computer technology
  - Establishing a process to support IT capital investment planning
  - Establishing interoperability standards
    - Equipment
    - Software (GIS, models, tools)
  - Training
  - Maintaining equipment
  - Obtaining and retaining qualified IT personnel
- Planning
  - Preparing for low-probability/high-impact national security threats

- Preparing for catastrophic events beyond the response capabilities of the local jurisdiction[1]

- Exercises
  - Back-filling positions so responders can leave their posts to participate in exercises
  - Planning, conducting, and evaluating exercises

- Training
  - Back-filling positions so responders can attend training
  - Sending personnel to training opportunities related to both national and jurisdictional program requirements.

EDUCATION AND TRAINING

The EM field will continue to evolve as more and more sophisticated models, tools, and software become available for EM and ES personnel to utilize for day-to-day preparation as well as for emergency response. Interviewees mentioned a wide spectrum of issues related to developing and sustaining computer skills, establishing a mentoring program to ensure smooth succession, maintaining corporate memory, and so on.

An important need stated by interviewees was more education and training not only in available models and other software, but also regularly scheduled training and routine refresher courses. Many people said that even if good software is available and accessible, it may not be used routinely. Therefore, users may not retain the information on how to use the software and may not have the proficiency to use it when needed for emergency response.

The following are other operational requirements identified by interviewees:

- Multiple modes of training delivery (video, web, self-service, e-learning) so that anyone can take a course anytime, anywhere
- Detailed software manuals with screenshots and summary "cheat sheets" to guide users
- "Train-the-trainer" approach and routine in-house training for important courses.

[1] Local jurisdictions are generally able to respond to and manage major disaster events. However, low-probability/high-impact threats would require significant external state and federal resources to ensure an initial response capability.

FEMA has many training courses in all areas of emergency management and for various emergency response disciplines, and it provides access to many educational tools such as the Joint Information Center. Interviewees expressed support for FEMA to establish more agreements with educational institutions, such as community colleges, for training and education, with arrangements to waive or discount tuition. Interviewees also suggested that FEMA invest more in alternative ways for learning, such as more training delivered electronically, via the web, and through learning media such as CDs and online classes.

Other training and educational requirements include the need for jurisdictions to train together to prepare for a multi-jurisdictional or interstate response. Interviewees often stated that not enough planning goes into a multi-jurisdictional response; instead, personnel must rely on past experience as the way to prepare for a response. The need for planning and coordination is paramount, particularly considering the variety of potential events (chemical, biological, terrorist, natural disaster, etc.). If jurisdictions plan together, they can also coordinate to share personnel and resources and to exchange ideas and best practices. ES personnel also need a model to transfer the knowledge of senior or retiring personnel to their ES successors, in the form of a mentoring program or specific classes to address succession planning and retention of corporate memory.

Interviewees expressed the need for training to be expanded to include cross-training for ES personnel, which they said would be ideal for multi-jurisdictional training classes. They indicated they want state and federal agencies to offer more sophisticated types of training such as role-based or "virtual" training. Other requirements include having a model for a more robust training program that provides for regularly scheduled (monthly, for example) training and refresher courses, including "networked" and live video training for geographically dispersed groups.

Training
Training requirements include the need for different training delivery options, better manuals, cross-training of personnel, sufficient funding, and IT training in both software acquisition and computer applications.

Availability of funding is one of the biggest obstacles to a robust training program:

- Insufficient funds are allocated and budgeted for training.
- Not all pertinent and necessary training can be accommodated, requiring that training needs be prioritized and severely restricted even though many personnel need training.
- ES organizations are not able to provide personnel with the training needed to build up the emergency management and response capabilities.

Resolution of these issues is considered operationally essential to an effective EM organization. The following are some specific operational requirements:

- Training in functional evaluation and analysis of software
- Training in methods and benefits to using computer tools day-to-day and during an event (continuous)
- Training in understanding barriers to interstate response and developing procedures for working together across state lines
- Implementable methods to ensure adequate opportunities for personnel to receive essential training
- Implementable methods to promote cross-training among response personnel
- Routine ongoing in-house training.

Chapter 4
Conclusions

The role of the ES community is unique for a number of reasons. Its performance needs to be at its strongest when the supporting infrastructure is at its weakest or even nonexistent. It has diverse responsibilities and component organizations at all jurisdictional levels that must operate in a coordinated and cooperative manner in order to be effective. In addition, the jurisdictions in this community face unique challenges related to communicating and sharing information with other jurisdictions and the public, both when preparing for and responding to an event, as well as when recovering from an event. Their work is further complicated by privacy, political, and social issues.

The ES community is using a wide variety of tools to facilitate event preparation and response. For example, many jurisdictions have software to capture, store, track, and disseminate information. They also use numerous manual tools such as guidebooks, checklists, and Excel spreadsheets. However, these models and tools are not sufficiently robust to support the modeling, simulation, and analysis that are crucial to ensuring the most efficient and effective response to an event. Moreover, they are rarely integrated, either across ES disciplines or across jurisdictions at all levels.

To best prepare for and respond effectively and efficiently to an event at the state and local levels, the ES community needs better models and other tools. In addition, all models and tools must support national assessments of preparedness and readiness as articulated in the 15 NPSs.

The functional requirements we identified are high-level, core areas of functionality that the ES community considers necessary in any model or tool they might use to prepare for, respond to, and recover from an emergency. The following functional requirements are key:

- Models and tools to support modeling for the 15 NPSs should be provided to all jurisdictions by DHS.
- Models and supporting tools should accept inputs from, and outputs to, commonly available software such as the Microsoft Office suite of products.
- Jurisdictions need a process to integrate model and tool use into everyday operations.
- To maintain continuity of operations, software must look and operate the same, regardless of mode: networked, LAN only, or standalone laptop.

- Software must integrate with other applications easily, scale up, and use familiar terminology, for support by nontechnical emergency personnel.
- Adoption and implementation of software must be possible for both well-funded jurisdictions and jurisdictions with no overhead funds.
- Maintenance of software must be very low cost and require minimal technical skills from using jurisdictions.
- Asset management tools must exchange data using some common, easy-to-use, and low-cost or no-cost standard or format.
- Software must include more than the technical information needed to implement it. Jurisdictions need information on different implementation paths and tools (such as checklists) to help them plan for, deploy, and support software.
- Jurisdictions need models to support three types of risk analyses: overall risk assessments, in-depth analyses of high-risk hazards and threats, and analyses of low-probability/high-impact threats.

DHS/S&T needs to define the functional requirements in more detail and then identify the specific technical requirements for modeling, simulation, and analysis.

The operational requirements we identified address items that are not directly linked to one specific module or specific requirement, but are nonetheless essential to the deployment and adoption of any of the pieces of the overall system. Generally, the operational requirements represent barriers that hamper the ability of almost all jurisdictions to adopt new models and tools, although the impact varies depending on factors such as location, population, executive support, and structure and size of the emergency services organization. In most cases, some of the operational requirements must be satisfied to implement software models and tools. Otherwise, the models and tools cannot be adopted, maintained, and used. The following are key operational requirements:

- Approaches and methods to easily and effectively engage all planning and general information sharing across all disciplines
- Guidance at the federal, FEMA region, state, and local levels on data and information sharing
- An integrated process to define the roles of the disciplines, the key responsibilities, and both the shared and the role-specific privileges of operations management software
- Decision support information from a trusted source in the ES community

- An authoritative source for guidance and standards in effect and a regular review process to ensure that they remain viable and up to date
- At the federal level, clear differentiation between what should be regarded as "guidance" and what constitutes "standards"
- Flexible, adaptable, and changeable processes for use by jurisdictions during both preparation for and response to an event
- Policies that support collaborative planning, risk-based funding, and processes or methods to resolve inter-jurisdictional differences of opinion and to address political issues.

The operational requirements reveal that more than a suite of models is needed. The ES community cannot adopt models and other software tools without a number of types of support including, for example, processes for

- determining which models they need, finding and selecting the right supporting software, and planning for and executing the software and model implementation;
- determining the full life-cycle cost of a software implementation (whether a model or supporting software) and for capital planning or other ways of funding the implementation; and
- contacting peers who operate in a similar environment (services provided, population served, funding limits, hazards) and have successfully implemented models or software tools.

DHS/S&T needs to address the operational requirements within its purview. However, some of these requirements can be addressed only by other organizations within DHS. S&T should partner with those organizations to ensure that the operational requirements are fully addressed. These partnerships are critical, because some operational requirements must be met if DHS is to overcome the barriers to the adoption of modeling, simulation, and analysis tools by the entire ES community.

Appendix A
Software and Other Tools

Table A-1 lists the software and other tools being used by the emergency management community. For each item listed, it shows the jurisdictions in our sample that use the software or tool, by population range.

Table A-1. Commercial Software

Item	1–14,999	15,000–49,999	50,000–99,999	100,000–249,999	250,000–499,999	500,000–999,999	1,000,000–4,999,999	Over 5 million	Statewide
ACAMS/FEMA				1 tribe		1 city			1 state
AEGIS (Records Management System)				1 city		1 city			
Aid-Matrix/FEMA								1 NGO	
Alert-Find/Message One							1 NGO		
Alliance Systems CAD		1 county							
ALOHA	1 county	2 counties	1 county	2 cities 1 county					1 state
AMANDA[a]				1 city					
ArcView Suite	1 county 1 tribe	1 county	2 counties	5 cities 2 counties 1 tribal consortium	2 counties 1 city	2 cities	1 NGO		7 states
Automated Flood Warning System/NWS				1 city		1 city			
BaseCamp				1 city/MMRS					
Bio-Surveillance						1 city			
BIO-Watch					2 cities		1 city		
Biz Recovery						1 city			
BREEZE–VOIP				1 city					
BROOM						1 city			
CAD				1 county	2 counties				
CAD–Alliance		1 county							
California Law Enforcement Technology Systems[a] (CLETS)								1 county	
CAMEO	1 tribe	2 counties	1 county	2 cities 1 county	1 county	1 city			2 states
Catastrophic Assessment Tool Set				2 cities 1 tribe					
CDC-Epi				1 city					
CDC–FluAide		1 county							
CERT–FEMA		1 county							

Table A-1. Commercial Software

Item	1–14,999	15,000–49,999	50,000–99,999	100,000–249,999	250,000–499,999	500,000–999,999	1,000,000–4,999,999	Over 5 million	Statewide
Chemical Reactivity Worksheet		1 county		1 city					
City Watch /AvTex		1 county			1 county				
City Watch/AvTex		1 county			1 county				
CODE RED			1 county						
Common Alerting Protocol									1 state
Continuity of Government/Strohl's	1 county								
Coordinated Assistance Network								1 NGO	
CrimeView/Omega				1 county					
D2PUFF					1 county				
DeLorme									1 state
DisasterLan Buffalo Computer Graphics				1 city					2 states
DMIS				1 city					1 state
DROMIS/FEMA/ARC Disaster Relief Operations System							1 NGO		
Electronic Patient Tracking System (EPTS) (Raytheon)						1 city			
EMCAPS					1 county				
EM Constellation							1 NGO		
Emergency Management Information Tracking System (EMITS)									1 state
Emergency Notification System/Purvis						1 city			
EmerGEO									1 state
EMNet									1 state
EMSystems					1 city				
Epi-Info CDC		1 county							
E-Plan/HazMat				1 city					
E-Team				2 counties	2 cities	1 city	1 NGO		
FDM Records Management System and CAD products				1 city					
FEMIS (free, but requires Oracle and other commercial products)					1 county				1 state
Fire House				1 city 1 county					
Fire View/Omega				1 county					

Table A-1. Commercial Software

Item	1–14,999	15,000–49,999	50,000–99,999	100,000–249,999	250,000–499,999	500,000–999,999	1,000,000–4,999,999	Over 5 million	Statewide
Firebase					1 city				
Fire-CAD						1 city			
First-Watch							1 city		
FluSurge 2.0/CDC				1 city					
Google Maps/Virtual Earth		1 county		1 city 1 tribe	2 cities	1 city 1 county	1 NGO		2 states
Han-Soft	1 county								
HAZUS				1 city 1 tribe	1 city	2 cities			6 states
HC-Standard					1 city				
Health Information Research Management	1 county								
HSEEP TOOLKIT	1 county	2 counties	2 counties	3 cities	2 cities	2 cities		1 county	3 states
HSEEP/N (NXS)					1 city	1 city			1 state
HSEEP/National Shelter System (NSS)									1 state
HTE's CAD			1 county						
HurrEvac				1 city	1 city	1 city		1 NGO	1 state
I-Link	1 county								
IPAWS									1 state
LARCOP								1 county	
Law Enforcement Online (LEO)					1 county		1 city		
Living Disaster Recovery Planning System—STROHL									1 state
Locally Developed Software				1 city 1 county		1 city		1 county	3 states
Lotus Notes Suite								1 NGO	
MABAS.ORG			1 county						
MarPlot		2 counties		2 cities					
Maximo				1 county			1 city		
Medical Surge				1 city					
Medicom							1 city		
Microsoft Access	1 tribe								1 state
Microsoft ASP.net									1 state
Microsoft Live									1 state
Microsoft Office Suite	2 counties	1 county	1 county	3 cities 1 tribe	3 cities 2 counties	1 city	1 city 1 NGO	1 county 1 NGO	3 states
Microsoft Sequel Server									2 states
Microsoft SharePointe				1 city 1 tribe		1 city			

Table A-1. Commercial Software

Item	1–14,999	15,000–49,999	50,000–99,999	100,000–249,999	250,000–499,999	500,000–999,999	1,000,000–4,999,999	Over 5 million	Statewide
Microsoft Systems Essentials 2007									1 state
Mir3		1 county							
National Weather Service products (NWS)		1 county	1 county	1 city 1 tribe		1 city			
NEMIS									1 state
New World				1 city 1 county					
NIMS-Cast				1 city 1 tribe	1 county	1 city			1 state
North Carolina–State Medical Asset, Resource Tracking (NC-SMART)					1 county				1 state
OASIS				1 city					
Orbit One								1 NGO	
PassagePoint								1 NGO	
Pictometry viewing capability				1 city					
Planning for Fires/Omega				1 county					
Pre Hospital Medical Information System					1 county				
Property Appraiser Records							1 NGO		
PS-NET						1 city			
Purvis Systems						1 city			
Q-T Modeler									1 state
Rapid Responder® Prepared Response, Inc.					1 city				
RazrWire					1 city				
Ready.gov FEMA			1 county	1 city 1 tribe	1 city	1 city			
Ready-Net							1 city		
Resource Manager						1 city			
Reverse 911				1 city	2 cities 2 counties	2 cities			1 state
RevEX/Trifolium									1 state
Riverine–FEMA									1 state
SATERN.org								1 NGO	
SDN Global								1 NGO	
SLOSH						1 city			1 state
Smart-PH	1 tribe								
Spillman					1 county				

Table A-1. Commercial Software

Item	1–14,999	15,000–49,999	50,000–99,999	100,000–249,999	250,000–499,999	500,000–999,999	1,000,000–4,999,999	Over 5 million	Statewide
Star Room							1 city		
Sync Matrix						1 city			
Synergen				1 county					
Telestaff/PDSI						1 city			1 state
TetroTech (Gray Prgs)									1 state
Tiger Census Data				3 cities 1 tribe					
ToughBooks		1 county							
Trimble GPS	1 tribe								
T-Soft						2 cities			1 state
U-Call/V-Call				1 city					1 state
WARN		1 county	1 county						
Weather Sentry–DTN Weather Service				1 city					
WebEOC		2 counties	2 counties	5 cities 1 county 1 tribe	2 counties	2 cities			7 states
Web-Fusion/ESI									1 state
Wind SpeedUp Model				1 county					
World Wind/NASA	1 tribe			1 tribe					1 state
Wyo-Link[a]		1 county	1 county						

Note: MMRS = Metropolitan Medical Response System; NGO = non-governmental organization; NWTEMC = North West tribal Emergency Management Council/Consortium.

[a] Developed by, and free to, USACE users; for non-USACE users, most models must be obtained from commercial sources.

Appendix B
Functional Requirements

This appendix lists, in Table B-1, the functional requirements identified by our interviewees. The requirements are grouped into the following categories:

- General technology
- Models
- Tools
- Tool integration
- Data.

Table B-1. Functional Requirements

Category	Requirement
General technology	Jurisdictions need federally supplied tools and plans to accommodate well-funded and minimally funded jurisdictions.
	Jurisdictions need to have access to tools/computer modeling that would help them better prepare for response.
	Jurisdictions need to factor in maintenance costs when deciding what tools to utilize for planning and response, as many jurisdictions do not have the in-house capability to handle management and maintenance of the systems and can't afford to get it.
	Jurisdictions need Emergency Management systems (ex: WebEOC), that are implemented by the State, to provide adequate access, training, licensure, version compatibility, and interoperability across platforms and applications commonly in use.
	Jurisdictions need capabilities similar to Virtual Alabama.
	Jurisdictions need tools that have asset tracking capabilities to exchange warehouse information on available resources.
	Jurisdictions need tools that have asset tracking capabilities to perform resource tracking, including 'typing' according to DHS requirements.
	Jurisdictions need tools that have logistics and resource management capabilities.
	Jurisdictions need tools that have asset tracking capabilities to perform asset visibility and tracking for people and other resources.
	Jurisdictions need tools and/or models to work for everyday operations, and scale up or down to support the size of the incident.
	Jurisdictions need a real-time dependable asset accountability system.
	Jurisdictions need access to non-emergency event management software and modeling in order to gain proficiency in the use of these tools for emergencies.
	Jurisdictions need technology tools that are sufficiently intuitive, easy to learn, and user friendly to allow effective utilization.

Table B-1. Functional Requirements

Category	Requirement
Models	Perform threat and risk analysis, then do SWOT analysis.
	Jurisdictions would like to have the capability to model and develop exercise scenarios.
	Jurisdictions would like to have the ability to model the capabilities needed to respond to an event, and then calculate the risk.
	Jurisdictions would like to have a tool to assist in planning for mass casualties in a given incident; they need to plan for realistic/most probable situations where jurisdictional capabilities are overwhelmed.
	Jurisdictions need tools to assist in earthquake modeling (HAZUS can be used for this but may not be widely known or used).
	Jurisdictions need tools for evacuation modeling.
	Jurisdictions would like a tool for the 15 NPS Scenarios, where they are allowed to put in some parameters and give some estimates. (This is in development; not too easy for locals to use, but maybe regional or state level.)
	Jurisdictions would like a model that will enable them to model low risk and high impact situations. They would like simple models for risk, to apply mitigation strategies as appropriate.
	Jurisdictions need models (and supporting tools) for planning & managing mass casualty events.
	Jurisdictions need scenario-based training with simulation that is fully computer based and virtual reality that includes role playing.
	Jurisdictions need a situational awareness tool with the caveat that each entity only sees their own info, but can be fully accessed at the EOC.
	Jurisdictions need real-time information regarding event conditions.
	Jurisdictions need databases of their own resources and resources available to them outside their jurisdiction.
	Jurisdictions would like a tool to estimate weather-related data (such as flooding), including details like inches per hour of rain.
Tools	Jurisdictions need a tool that will update EM Plans at least once a year or when substantial amendments need to be instituted.
	Jurisdictions need tools to support a process to capture lessons learned with a closed loop change process.
	Jurisdictions need to capture input from groups with unique expertise and resources for dealing with special populations.
	Jurisdictions would like tools to perform risk management (risk identification, assessment, risk prioritization and response planning, and risk monitoring.
	Jurisdictions would like to have a planning, training, and exercise tool where they can enter in criteria and have the tool generate an executable model, plan, or exercise scenarios.
	Jurisdictions need a tool for planning for “medical surge”; would like to have access to tools/computer modeling that would help them better prepare for response.
	Jurisdictions would like a “nationwide credentialing system” to track KSAs.
	Jurisdictions would like templates for Memorandums of Understanding (MOUs) so that they can facilitate getting these with the appropriate groups.
	Jurisdictions need to establish a professional portal specifically for access by emergency services personnel with appropriate access to a menu of all available functions and tools.
	Jurisdictions need a web-accessible tool for first responders and up-to-date floor-plans for public, private and school buildings, including 360 degree facility and area photos.

Table B-1. Functional Requirements

Category	Requirement
	Jurisdictions would like a database of hotels/motels/visitor accommodations could be used as emergency short term shelters.
	Jurisdictions need a real time capability to identify the availability of resources needed by a jurisdiction that could be provided by a neighboring jurisdiction or outside resources.
	Jurisdictions need a tool that will capture information from the Pacific Disaster Warning Center/Pacific Tsunami Warning Center, NOAA, Universities, U.S. Forest Service, State Forestry, Weather Service, etc.
	Jurisdictions would like to go to a central location to see tools that everyone else is using, as well as to see what type of access exists for these tools.
	Jurisdictions need a centralized repository for plans and planning documentation.
	Jurisdictions would like to have tools to estimate resource requirements.
	Jurisdictions would like a tool for all-hazards planning; generally in the form of detailed and comprehensive checklists, which would prompt the user with questions and best practices.
	Jurisdictions would like tools that will enable them to disseminate information to special populations, and also an application (maybe self-service) to let 'special needs' populations voluntarily register (non-English speakers, mobility impaired, etc.).
	Jurisdictions would like tools to let 'special needs' populations voluntarily register (non-English speakers, mobility impaired, etc.).
	Jurisdictions would like a tool that has pre-planning information, such as certain types of addresses and occupancies.
	Jurisdictions need a tool to publish self-help information in phonebooks for visitors and residents for personal planning and response to potential local emergency threats.
	Jurisdictions need a central repository for database layers, which can be fully accessed at the EOC, to provide data and tools for risk analysis, deployment and tracking available resources, situational awareness, as well as the preparation of reports and briefings.
	Jurisdictions would like a central repository to document exercises and simulations based on information in other systems such as WebEOC; capture and retrieve after-action reports (AARs) and lessons learned documentation.
	Jurisdictions need tools that provide locations for points of distribution (for resources, supplies); a tool to better manage regional response assets.
	Jurisdictions would like a tool that provides state-wide GIS capabilities, such as "Virtual Alabama", and contains information on who owns the land and populated areas, and property line information.
	Jurisdictions would like the ability to identify response capabilities and resource location.
	Jurisdictions would like to have a tool that can capture specific information about events, which can then be shared among response agencies. Therefore, providing a central repository for information about any event.
	Jurisdictions need modeling capabilities for post-event analysis and data capture (for example, to survey public officials about what worked/didn't work).
	Jurisdictions need resource databases are needed for deployment and tracking, and which can be viewed real-time during an event.
	Jurisdictions need grants to cover scheduling tools and/or software.
	Jurisdictions need grants to cover command and control technology for tracking vehicles and personnel.
	Jurisdictions need grants to cover MDT's.

Table B-1. Functional Requirements

Category	Requirement
	Jurisdictions need grants to cover satellite communications that would ensure redundancy.
	Jurisdictions need video streaming capability for interoperability.
	Jurisdictions would like to have regular notifications and alerts from forestry agencies and access to details about any forestry-related events, with drill-down to detail.
	Jurisdictions would like a tool that provides inventory management capabilities.
	Jurisdictions need tools for expedient evaluation of event results.
	Jurisdictions would like tools that enable barcode and scanner-enabled material management.
	Jurisdictions would like tools that will enable them to disseminate information to the public.
	Jurisdictions would like tools that will enable them to disseminate information both static and dynamic/real-time to the public
	Jurisdictions would like tools that have asset tracking capabilities.
	Jurisdictions would like a tool that tracks responders within buildings (underground?).
	Jurisdictions would like tools for video conferencing.
	Jurisdictions would like a web-based system for tracking volunteers–interactive for the volunteer to self enter data; a self-service application.
	Jurisdictions would like a tool to track donations.
	Jurisdictions would like a tool to track requests for assistance.
	Jurisdictions need a way to track expenditures for public works departments.
Tool integration	Jurisdictions would like the ability to process and produce an interoperable system acceptable across IT departments as well as EOCs.
	Jurisdictions would like the ability to identify the availability and prioritization of applications/programs suitable for integration with a variety of products such as the ArcView suite.
	Jurisdictions would like the ability to communicate and share information with communities of similar size and resources in order to stay abreast of best management practices.
	Jurisdictions would like tools need to be developed using a flexible, open architecture in order to work across systems and hardware.
	Jurisdictions would like a tool to tie in information and form data between the local emergency management folks, FEMA, the localities, and the State (while also taking into account the Budget, funding, thresholds, etc.), and then navigate the bureaucratic paperwork and workflow.
	Jurisdictions would like network capability to involve all satellite locations for training.
	Jurisdictions want the ability to wirelessly integrate CAD data with field assessments to assign and track activities and progress of cleanup/recovery crews.
	Jurisdictions would like a standard interoperable tool suite that will interoperate at all population levels.
	Jurisdictions would like a standard interoperable tool suite that extend beyond communications, should apply to all systems and all disciplines.
	Jurisdictions would like a standard interoperable tool suite that should have the ability to plug and play.
	Jurisdictions would like a standard interoperable tool suite that interact real time during an event, as well as day-to-day.
	Jurisdictions need larger jurisdictions to encourage the virtual participation of smaller jurisdictions in the daily use of EOC software to share perspectives on planning and response requirements.

Table B-1. Functional Requirements

Category	Requirement
	Jurisdictions need to integrate all the information needed to address all critical elements required for event management.
	Jurisdictions need a nationwide standard for Emergency Management taxonomy and data exchange so that various tools/software can transmit data between different tools created by different vendors (or for tools developed in-house.)
	Jurisdictions need FEMA regions to support and standardize on either specific software applications (ex: WebEOC) or on critical data exchange functions commonly in use throughout their Region.
	Jurisdictions need states to ensure local accessibility and stable communication links for applications [such as WebEOC] which they have installed and implemented.
	Jurisdictions need tools and models to integrate data capture and use for exercise simulation and documentation.
	Jurisdictions need storm surge data that can be overlaid on flood-zone maps and then integrated w/reverse 911 information.
	Jurisdictions need to integrate plume data in CAMEO with the GIS system and reverse 911.
	Jurisdictions need data pertaining to EPA Tier II, or Hazmat.
	Jurisdictions would like the capability to integrate surveillance and command/control functions into a single portal for pandemic flu.
	Jurisdictions need WebEOC to link to not only counties, but also to cities.
	Jurisdictions would like systems to connect to integral nongovernmental components of emergency response such as the American Red Cross.
	Jurisdictions would like the capability to integrate data across all tools, not just GIS: could be standards driven or could be a separate application tool (UDEF).
	Jurisdictions need tools that have asset tracking capabilities need to be consistent with DHS/NIMS and WebEOC.
	Jurisdictions would like tools to capture data at the finest level of granular detail, to support later aggregation of the data in various ways, such as: all pertinent post-incident data to prepare a Governor's request to the President for a disaster declaration which would provide for cost recovery. (Post Event Accounting)
	Jurisdictions need EOCs to see what another EOC in its jurisdiction/county/state/region is seeing, for example real-time visual links and data uploads/downloads, video streaming, etc.
	Jurisdictions need WebEOC to exchange information and/or have compatibility between versions.
	Jurisdictions need data that is easy to integrate on simulated maps (Virtual Alabama is an example of this).
	Jurisdictions need to integrate facility plans for buildings with GIS.
	Jurisdictions would like a tool that provides a live feed into emergency dispatch center with POCs for each location in an event.
	Jurisdictions need clear guidelines for electronic tracking of resource expenditures for all response agencies.

Table B-1. Functional Requirements

Category	Requirement
Data	Jurisdictions need to retain “historic” data for specific response activities to use in estimating future response needs.
	Jurisdictions need to have a Resource Tracking and Situational Awareness tool with the caveat that each entity only sees their own info, but can be fully accessed at the EOC.
	Jurisdictions need a common EM data standard, nor a process for exchanging data.
	Jurisdictions need a common operating capability for exchanging data–county to county/county to state/state to state, and so on. They would like FEMA to take the lead in addressing this need.
	Jurisdictions need local EMAs to access continuous critical data, such as weather information, that would assist them in planning and responding effectively.
	Jurisdictions need standard data to describe the resources needed real time during an event.
	Jurisdictions would like a clearinghouse for EM data: casualties under scenarios, etc.
	Jurisdictions need field collection of data is needed for analysis for planning.
	Jurisdictions need weather information to not be localized and available more than just Monday through Friday via state systems.

Appendix C
Use of the Vulnerability Analysis Chart

FEMA designed the Vulnerability Analysis Chart to assist jurisdictions with prioritizing resources according to the potential risk. This appendix describes how the Vulnerability Analysis Chart is used.

Table C-1 is an example using the matrix to provide an estimation of potential vulnerability to common threats:

- "Probability" and "Impacts" are rated on a scale of 1 to 5, with 1 being low and 5 being high; 0 indicates no risk.
- "Capability" is also rated on a scale of 1 to 5, with 1 being the best (the lower the number, the greater the capability is to respond, thus reducing the risk).
- For all listed hazards, the highest numerical level of risk is 648. In our example, the risk level is 278, which indicates that a significant amount of planning needs to occur.

Table C-1. Vulnerability Analysis Chart—Example

Type of emergency	Probability (0 = low, 5 = high)	Impacts (0 = low, 5 = high)			Capability (1 = best, 5 = worst)		Risk
		Human	Property	Business	Internal resources	External resources	Total 0 to 30
Chemical	2	5	5	5	2	1	20
Dam failure	4	5	4	5	2	1	21
Earthquake	2	5	4	5	2	1	19
Fire or wildfire	0	0	0	0	0	0	0
Flood	3	5	5	5	2	1	21
Hazardous material	5	5	5	5	3	1	24
Heat	4	4	3	2	2	4	16
Hurricane	3	5	5	5	4	4	26
Landslide	0	0	0	0	0	0	0
Nuclear power plant emergency	0	0	0	0	0	0	0
Terrorism	1	5	5	5	4	3	23
Thunderstorm	5	2	4	3	3	4	21
Tornado	5	5	5	5	4	4	28
Tsunami	0	0	0	0	0	0	0

Table C-1. Vulnerability Analysis Chart—Example

Type of emergency	Probability (0 = low, 5 = high)	Impacts (0 = low, 5 = high)			Capability (1 = best, 5 = worst)		Risk
		Human	Property	Business	Internal resources	External resources	Total 0 to 30
Volcano	0	0	0	0	0	0	0
Wildfire	3	2	5	3	3	3	19
Winter storm	2	5	5	5	2	2	21
Special events	3	3	4	4	2	3	19
Cumulative vulnerability (0 to 648)	42	56	59	57	35	32	278

When this process is applied to a single threat, other factors are taken into account. Some basic assumptions are made about the threat and are weighted on a scale of 0 to 5 in the same manner as in the vulnerability analysis above.

In the following two scenarios of a special event, a summer riverboat festival, several factors are considered. An empirical weight is applied to reflect the jurisdiction's population anticipated to be in the risk area. The visitor population that might also be attending is treated similarly. The local capabilities are also factored in, with the best capability being a 1 and the worst rated as 5. Since weather can be a major factor in this scenario, a weight is applied for that as well. Any other external factors can also be included in the planning matrix. Because this process is used to motivate adequate planning among potential responders, it is a simple method for reflecting relative risk and planning for an appropriate emergency response if needed.

The following are the basic assumptions for the first scenario:

- A summer riverboat festival is to be held in July.
- The total community population is 60,000, with 30 percent of the population expected to be in the risk area.
- The anticipated visitor population is 5,000, raising the population at risk to 23,000.
- The weather will be typical for that area at that time, so it is given a low weight.
- The primary external factor will be the number of boats on the river during the event, which could raise the level of risk.
- Internal and external resources necessary for these various factors are weighted.

Table C-2 shows the results.

Table C-2. Special Event—Scenario 1

Factors	Local estimates (0 = low; 5 = high)	Impacts (0 = low; 5 = high)			Capability (1 = best; 5 = worst)		Risk
		Human	Property	Business	Internal resources	External resources	Total 0 to 30
Community population in risk area (0 [low] to 5 [high])	3	3	1	1	3	4	15
Visitor population in risk area (0 [low] to 5 [high])	2	3	1	0	3	4	13
Weather (0 [mild] to 5 [life threatening])	2	3	1	1	3	1	11
External factors (1 [best] to 5 [worst])	4	4	4	2	5	5	24
Cumulative vulnerability (0 to 120)	11	13	7	4	14	14	63

The second example illustrates a different scenario using the community population factor but different conditions. The basic assumptions for the second scenario are as follows:

- A summer riverboat festival is to be held in July.
- The total community population is 60,000, with 30 percent of the population expected to be in the risk area.
- The anticipated visitor population is 20,000, raising the population at risk to 38,000.
- The weather will be hotter than usual for that area at that time, so it is given a higher weight.
- The primary external factor will be the number of boats on the river during the event, which could raise the level of risk.
- Internal and external resources necessary for these various factors are weighted in relation to their ability to respond given these conditions.

Table C-3 shows the results. As one would expect, the second scenario has a higher the risk—88 out of a possible 120, compared to 63 for the first scenario. This result indicates the need for cooperation among local emergency service agencies to plan and arrange for outside resources to be on standby to assist as

necessary. The process can be as simple or as complex as necessary to ensure adequate planning and mitigation.

Table C-3. Special Event—Scenario 2

Factors	Local estimates (0 =low, 5 = high)	Impacts (0 = low, 5 = high)			Capability (1 = best, 5 = worst)		Risk
		Human	Property	Business	Internal resources	External resources	Total 0 to 30
Community population in risk area (0 [low] to 5 [high])	3	3	1	1	3	5	16
Visitor population in risk area (0 [low] to 5 [high])	5	5	2	3	4	5	24
Weather (0 [mild] to 5 [life threatening])	3	5	1	1	4	5	19
External factors (1 [best] to 5 [worst])	5	5	5	4	5	5	29
Cumulative vulnerability (0 to 120)	16	18	9	9	16	20	88

Appendix D
Operational Requirements

This appendix lists, in Table D-1, the operational requirements identified by our interviewees. The requirements are grouped into the following categories:

- Coordination
- Culture
- Education and training
- Funding
- Information
- Interoperability
- Policy
- Processes
- Standards.

Table D-1. Operational Requirements

Category	Functional requirement
Coordination	Jurisdictions would like a tool to track donations.
	Jurisdictions would like a tool to track requests for assistance.
	Jurisdictions would like a tool that tracks responders within buildings (underground?).
	Jurisdictions need a way to track expenditures for public works departments.
	All disciplines at the table for planning, information sharing.
	Routine monthly in-house training.
	Cooperative agreements with community colleges to waive fees for classes for public safety personnel.
Culture	Use of non-emergency event management software and modeling leads to proficiency in the use of these tools for emergencies (daily, etc.).
	Seeking input from groups with unique expertise and resources for dealing with special populations.
	Larger jurisdictions encourage virtual participation of smaller jurisdictions in the daily use of EOC software to share perspectives on planning and response requirements.

Table D-1. Operational Requirements

Category	Functional requirement
Education and training	Jurisdictions need scenario-based training with simulation and virtual reality that includes role playing and is fully computer based.
	Jurisdictions need to be able to train together to prepare for situations involving interstate response to large disasters.
	Jurisdictions need to coordinate emergency management training/education through local community colleges; waive all class fees for public safety.
	Jurisdictions need processes that will help identify functions that jurisdictions need to perform better, and incorporate software that will best meet their functional requirements.
	Cross-training of all response personnel.
	A mentoring program for knowledge transfer to relevant EM employees to deal with attrition (brain drain) through retirement and career change.
Funding	Jurisdictions need grants to cover IT personnel, software maintenance, and other software lifecycle costs.
	Jurisdictions need grants to cover ongoing training.
	Jurisdictions need grants to cover routine exercises.
	Jurisdictions need grants to cover scheduling tools/software.
	Jurisdictions need grants to cover command and control technology for tracking vehicles and personnel.
	Jurisdictions need grants to cover HazMat PPE, as well as training and maintenance.
	Jurisdictions need grants to cover satellite communications that would ensure redundancy.
	Jurisdictions need grants to cover MDTs.
	Federal funding is either not provided or not sustained for acquisition, training, operation, or maintenance of software/systems that are programmatically mandated or if there is an implied mandate when acquisition eligibility is federally authorized.
	The perspective of many local jurisdictions is that tools for managing the grants process don't provide for the frequent changes in federal policy and regulations which results in unanticipated and undue burdens on local jurisdictions.
Information	Jurisdictions need real-time information regarding event conditions.
	Jurisdictions need databases of their own resources and resources available to them outside their jurisdiction.
	There is a lack of access by local EMAs to continuous critical data, such as weather information, that would assist them with planning and responding effectively.
	Jurisdictions would like to have regular notifications and alerts from forestry agencies and access to details about any forestry-related events, with drill-down to detail.
	Jurisdictions need tools and/or models to work for everyday operations and to scale up or down to support the size of the incident.
	Jurisdictions would like a nationwide credentialing system to track KSAs.
	Jurisdictions would like tools that enable barcode and scanner-enabled material management.

Table D-1. Operational Requirements

Category	Functional requirement
Information	Jurisdictions would like tools that will enable them to disseminate information to the public.
	Jurisdictions would like tools that will enable them to disseminate information both static and dynamic/real-time to the public.
	Jurisdictions would like tools that will enable them to disseminate information to special populations, and also an application (maybe self-service) to let special-needs populations (non-English speakers, mobility-impaired people, etc.) voluntarily register.
	Tools that have asset tracking capabilities need resource tracking, including "typing" according to DHS requirements. (Would like an online place so they could put up checklists.)
	Tools that have asset tracking capabilities need to perform asset visibility and tracking: people and other resources.
	Tools that have asset tracking capabilities need to provide the capability to exchange warehouse information on available resources.
	Jurisdictions need real-time dependable asset accountability system (related to asset tracking).
	Jurisdictions would like a web-based system for tracking volunteers–interactive for the volunteer to enter data; a self-service application.
	Jurisdictions need tools that provide locations for points of distribution (for resources, supplies); a tool to better manage regional response assets.
	Jurisdictions would like a tool that has information needed for planning, such as certain types of addresses and occupancies.
	Jurisdictions would like a tool that provides state-wide GIS capabilities (such as "Virtual Alabama") and contains information on who owns the land and populated areas, as well as property-line information.
	Jurisdictions would like to have a tool that can capture specific information about events, which can then be shared among response agencies, providing a central repository for information about any event.
	Jurisdictions need WebEOC to exchange information and have compatibility between versions.
	Jurisdictions need tools and models to integrate data capture and use for exercise simulation and documentation.
	Jurisdictions require data that are easy to integrate on simulated maps (Virtual Alabama is an example of this).
	Jurisdictions need storm surge data that can be overlaid on flood-zone maps and then integrated with reverse 911 information.
	Jurisdictions would like a clearinghouse for EM data: casualties under scenarios, etc.
	Jurisdictions need a tool that will capture information from the Pacific Disaster Warning Center/ Pacific Tsunami Warning Center, NOAA, universities, U.S. Forest Service, State Forestry, Weather Service, etc.
	Communication and sharing of information with communities of similar size and resources in order to stay abreast of best management practices.
	Publish self-help information in phonebooks for visitors and residents for personal planning and response to potential local emergency threats.

Table D-1. Operational Requirements

Category	Functional requirement
Interoperability	Tools that have asset tracking capabilities need to be consistent with DHS/NIMS and WebEOC.
	Tools that have asset tracking capabilities need logistics and resource management capability.
	Jurisdictions need EOCs to see what another EOC in its jurisdiction/county/state/region is seeing, for example, real-time visual links, data uploads/downloads, and video streaming.
	Tools need to be developed using a flexible, open architecture to work across systems and hardware.
	Jurisdictions need to integrate plume data in CAMEO with the GIS and reverse 911.
	Jurisdictions need to integrate facility plans for buildings with GIS.
	Jurisdictions would like the capability to integrate surveillance and command/control functions into a single portal for pandemic flu.
	Retain "historical" data for specific response activities to use in estimating future response needs.
	Use of video streaming capability that contributes to interoperability.
Policy	Availability of funds determines how often, or if, plans can be exercised.
	Federal, state, and local funds are limited and do not cover full participation in exercises.
	There is a lack of technical personnel for IT dedicated positions who also understand and are able to support specific emergency management issues.
	Jurisdictions need a policy on how to mitigate limiting factors (managing software once we get it, sustainment, staff or money).
Processes	Some areas have limited training and restricted access to control data entry to ARC GIS maps.
	Identification of the technology functions that a jurisdiction needs to function more effectively and efficiently.
	Jurisdictions would like a process to evaluate software that will best meet their functional requirements.
	Jurisdictions would like a tool that provides inventory management capabilities.
	Jurisdictions need to perform risk management (risk identification, assessment, risk prioritization and response planning, and risk monitoring). This will enable them to model low-risk and high-impact situations. They would like simple models for risk, to apply mitigation strategies as appropriate.
	Jurisdictions would like to have tools to estimate resource requirements.
	Jurisdictions need tools for expedient evaluation of event results.
	Jurisdictions need tools for evacuation modeling.
	Jurisdictions would like templates for memorandums of understanding so that they can facilitate getting these with the appropriate groups.
	Jurisdictions would like tools to let special-needs populations (non-English speakers, mobility-impaired people, etc.) voluntarily register.
	Jurisdictions need tools for planning and managing mass casualty events.
	Jurisdictions would like the ability to identify response capabilities and resource location.
	Jurisdictions would like a tool that provides a live feed into emergency dispatch center with POCs for each location in an event.

Table D-1. Operational Requirements

Category	Functional requirement
	Jurisdictions need flu surveillance and command and control.
	A tool to tie in information and form data between the local emergency management people, FEMA, the localities, and the state (while also taking into account the budget, funding, thresholds, etc.), and then navigate the bureaucratic paperwork and workflow.
	Jurisdictions need R&D regarding processes and cross-agency boundaries for funding mechanisms.
	Jurisdictions would like a central repository to document exercises and simulations based on information in other systems such as WebEOC and to capture and retrieve After Action Reports and lessons learned documentation.
	Jurisdictions need a process to handle maintenance costs, which are a major factor in establishing a system. They do not have in-house capability to handle management and maintenance of the systems and cannot afford to get it.
	Jurisdictions need processes for using large events to put plans into action more frequently.
	Jurisdictions need processes to produce an interoperable system across IT departments as well as EOCs.
	Jurisdictions need to learn about software/IT and the SDLC and to become familiar or get this expertise to do a “minimal” job themselves.
	Tools to support a process to capture lessons learned with a closed loop change process.
	Inclusion of representatives from special-population facilities (such as prisons, institutions, etc.) to participate in a community-wide planning effort for response.
Standards	FEMA regions fail to support and standardize on either specific software applications (for example, WebEOC) or on critical data exchange functions commonly in use throughout their region.

Appendix E
Abbreviations

COP	common operating picture
DHS	Department of Homeland Security
EM	emergency management
EMA	emergency management agency
EMCAPS	Electronic Mass Casualty Assessment and Planning Scenarios
EOC	emergency operations center
ES	emergency services
FEMA	Federal Emergency Management Agency
GIS	geographic information system
IT	information technology
LAN	local area network
MNS	mission needs statement
MOU	memorandum of understanding
NGO	non-governmental organization
NIC	National Integration Center
NPS	National Planning Scenario
OASIS	Organization for the Advancement of Structured Information Standards
S&T	Directorate for Science and Technology
SDLC	software development life cycle
SWOT	strengths, weaknesses, opportunities, and threats
UASI	Urban Area Security Initiative

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
01-2009	Final	9/28/07 – 1/30/09

4. Title And Subtitle

Modeling, Simulation, and Analysis for State and Local Emergency Planning and Response: Operational Requirements Document

5a. CONTRACT NUMBER
HSHQDC-08-F-00002

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Duncan, Denise R.
Gribko, Joana R.
Kolachina, Roja
Lee, Myra T.

5d. PROJECT NUMBER

5e. TASK NUMBER
DHS82

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

LMI
2000 Corporate Ridge
McLean, VA 22102-7805

8. PERFORMING ORGANIZATION REPORT NUMBER
DHS82T2

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Lawrence E. Skelly II, Deputy Director
Infrastructure & Geophysical Division
Science and Technology Directorate
U.S. Department of Homeland Security
Washington, DC 20528

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

A Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Department of Homeland Security provides support to 'first responders' in jurisdictions throughout the United States. These responders must plan for various threats and their response to various emergency scenarios. Under this task, LMI gathered requirements from a sample of the emergency management community at the local, state, and tribal levels. This Operational Requirements Document addresses both the requirement for modeling and simulation to support various emergency management functions and the requirements for training, maintenance, and other support to enable the use of modeling and simulation software.

15. SUBJECT TERMS
modeling, simulation, and analysis; state and local emergency planning and response; operational requirements document; Department of Homeland Security; first responders

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE	Unclassified Unlimited	85	Nancy E. Handy
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED			19b. TELEPHONE NUMBER *(include area code)* 703-917-7249